COMPARISON OF SIX HOLE V/S FOUR HOLE MINI PLATES FOR OPEN REDUCTION AND INTERNAL FIXATION OF ISOLATED, UNILATERAL FRACTURE ANGLE OF MANDIBLE

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BRANCH – III

ORAL AND MAXILLOFACIAL SURGERY

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY
CHENNAI – 600 032

2012 - 2015

CERTIFICATE

This is to certify that **Dr. A. SENTHILKUMAR**, Post Graduate student (2012–2015) in the Department of Oral and maxillofacial Surgery, Tamil Nadu Government Dental College and Hospital, Chennai – 600 003 has done this dissertation titled **"COMPARISON OF SIX HOLE V/S FOUR HOLE MINI PLATES FOR OPEN REDUCTION AND INTERNAL FIXATION OF ISOLATED, UNILATERAL FRACTURE ANGLE OF MANDIBLE"** under my direct guidance and supervision in partial fulfillment of the regulations laid down by **The Tamil Nadu Dr. M.G.R. Medical University**, Chennai –600 032 for **M.D.S.,** (Branch – III) **Oral and Maxillofacial Surgery** degree examination.

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PLACE OF STUDY	Tamil Nadu Government Dental College & Hospital, Chennai-600003
DURATION OF THE COURSE	3 Years
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Title of the work: " Comparision of six hole v/s four hole mini plates for open reduction and internal fixation of isolated unilateral fracture angle of mandible"

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Nothing is impossible unless you think it is.

- Sri Sri Paramahansa Yogananda.

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ABSTRACT

BACKGROUND:

The purpose of this study is to compare the clinical outcomes in patients treated by six hole v/s four hole mini plates for open reduction and internal fixation of isolated, unilateral fracture of the angle of mandible.

MATERIALS & METHODS:

In this study 20 patients who reported to Department of oral & maxillofacial surgery, Tamilnadu Government Dental college & hospital, Chennai, with isolated (unilateral) fracture of angle of the mandible were selected. The inclusion criteria was simple & compound fracture (linear, non-comminuted) with or without occlusal derangement, isolated unilateral angle fractures, all healthy individuals between 20-45 years of both sexes, dentulous patients, patients willing for a followup for atleast 3 months were included. The exclusion criteria was severely comminuted or infected fractures, edentulous patients, mandibular fractures other than fracture of the angle, associated midfacial fractures, medically compromised patients. The sample size was 20 patients 10 in each group, in group I patients were treated with a single (2mm) titanium miniplate 4 hole with gap and four 2x8mm titanium screws and in group II patients were treated with single (2mm) titanium mini plates 6 hole with gap and six 2x8mm titanium screws. Patients were treated with modified ward's incision or anterior ramal incision intra orally and internal fixation done. Wound closed with 3-0 vicryl.

RESULTS:

In all these patients it is observed that there is a gradual improvement in the mouth opening after open reduction with internal fixation, Bite force values clinically proved that there is a significant improvement in the masticatory efficiency of the individual after the surgical management. The intra operative time was found to increase in patients with displaced angle fracture, where considerable time was taken to reduce the fracture to an anatomical alignment. and a normal occlusion in all patients was achieved post operatively, with a follow up period of 3 months.

CONCLUSION:

Comparison between a 4 hole 2mm miniplate and a 6 hole 2mm miniplate in this study suggests that there is a better stability of fragments when three screws were placed on either side of the fracture. To conclude, both the 2mm- 4 hole and 6 hole miniplate osteosynthesis provides favourable clinical outcomes in treating the isolated unilateral fracture angle of the mandible with minimal complications. However further studies with a larger sample size eliminating the confounding factors are required to ascertain the clinical benefits of one type of plate over the other.

ABBREVIATION

1.	**AO-ASIF**	-	Association for the Study of Internal Fixation - Arbeitsgemein Schaft für Osteosynthese Fragen
2.	**MMF**	-	Maxillo Mandibular Fixation
3.	**TMJ**	-	Temporo Mandibular Joint
4.	**ORIF**	-	Open Reduction and Internal fixation
5.	**3D**	-	Three Dimentional
6.	**LMP**	-	Locking Miniplate
7.	**FEA**	-	Finite Element Analysis
8.	**DCP**	-	Dynamic Compression Plate
9.	**IAN**	-	Inferior Alveolar Nerve
10.	**OPG**	-	Ortho Pantomogram

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The incidence of the fracture of the angle of the mandible constitutes of 0% to 32%.[1] It contributes the largest percentage of the mandibular fracture because of,

1. The thin cross sectional area,
2. Presence of the 3rd molar in the angle,
3. Abnormal muscle forces, abrupt change in shape from horizontal to vertical ramus.[10]

The method of treatment of fracture of the mandible has undergone a gradual evolution, and plethora of techniques have been introduced by many surgeon's ranging from,

1. Maxillomandibular fixation,
2. Combination's of Maxillomandibular fixation and wire osteosynthesis,
3. Lag screw and
4. Plate fixation.

The current trend in treating the fracture of the angle of the mandible is using Non-compression semi rigid internal fixation plating system. The advantage of semi rigid internal fixation is,

1. Avoidance of maxillomandibular fixation,
2. Early movement of the mandible,
3. Utmost satisfaction of the patient,
4. Lesser period of stay in the hospital.

Use of non-compression adaptive system of miniplates was advocated by Michelet et al and popularised by champy et al. Mininplate osteosynthesis system is accomplished by placement of the plate along the "Ideal line of osteosynthesis" thereby counter acting the displacing forces which occur during the mandibular movements.[8]

Single miniplate along the upper border of the fracture angle of the mandible has the potential advantage of lowest morbidity and minimal complications. It has been documented in the literature that placement of two miniplates are not effective than the single plate for fracture angle of the mandible since there is a risk of infection in placing additional plate at the inferior border even though it produces more stability.[9]

Fracture of the angle of the mandible predominantly occur posterior to the dentition, preventing the adequate stabilisation by maxillomandibular fixation. Hence it is always ideal to treat the fracture of the angle of the mandible by open reduction and internal fixation.[8] Intra oral open reduction and internal fixation provides simultaneous observation of fracture line reduction and occlusal relationship. It avoids the large external scar, risk of injury to the marginal mandibular nerve.[8]

Functional stability has to be achieved both intra operatively and post operatively following miniplate osteosynthesis system, since there is a risk of infection at the fracture site if there is a failure in providing good functional stability.[8]

Currently surgeon's are attracted predominantly to the usage of "4 hole" plate with gap for the fracture of the the angle of the mandible. But still some unforeseen consequences do occur in the usage this semirigid miniplate fixation system. The complication rate though minimal has not reduced substantially with this semirigid superior border plates because of the material and the host factor. Some surgeon's believe in using "six hole with gap" titanium miniplate for fracture angle of the mandible assuming to provide more functional stability, as suggested by AO-ASIF. Literature pertaining to comparison of four hole with gap versus six hole with gap titanium miniplate for fracture of the angle of the mandible are very scarce.

This study was conducted on 20 Patients who reported to the Department of Oral & Maxillofacial surgery Tamilnadu Government Dental College and Hospital, with isolated fracture angle of the mandible. The patients were treated with four hole with gap and six hole with gap titanium miniplates.

AIM

The purpose of this study is to compare the clinical outcomes in patients treated by six hole v/s four hole mini plates for open reduction and internal fixation of isolated, unilateral fracture of the angle of mandible.

OBJECTIVES:

To evaluate and compare the efficacy in the following parameters between both the groups:

1. Adaptability of plates.
2. Access to retromolar trigone during last screw placement.
3. Stability of plates.
4. Stability of fragments.
5. Occlusion.
6. Bite force.
7. Mouth opening.
8. Neuro sensory deficits.
9. Wound infection & dehiscence.

INCIDENCE & ETIOLOGY:

The mandible is one of the bones most susceptible to trauma in facial region due to its more projected position in facial skeleton[6]. Mandible angle fractures account for 23 to 42% of all facial fractures and have high complication rates (0 to 32%).[5] The angle is the transition zone between dentate and edentate region and is commonly associated with impacted teeth[13]. The term angle is derived from lateral view of the transition between the body and vertical ramus[13].

Mandible angle fracture has highest complication rates due to, method of treatment, time between injury & treatment, oral health of the patient, presence (or) absence of tooth in the line of fracture[16]. Reduction of bone strength may be caused by physiological atrophy, osteoporosis, pathological process[19].

Angle of mandible forms an area lower resistance which contains thicker upper body, thin basilar bone[19]. Fracture of mandible occurs when the strength of the bone and forces acting on it are not equal[19].

Duan and Zang stated that when the mandible is submitted to low force trauma, the presence of 3rd molar predisposes the bone to fracture in mandibular angle, due to study of Szucs et al showed that mandibular external oblique ridge on each side was the location where "stress was concentrated" and Mandibular 3rd molars are usually situated close to ridge[6].

Pattern & direction of fractures

depends on,

1. Amount of energy exerted by the force,
2. Direction of the vector of the force,
3. Muscle attachment and their counteracting forces,

TREATMENT MODALITIES:

Many treatment approaches have been used for the fixation of angle fractures. However, optimal treatment of angle fractures remains controversial. So, one of the most frequently used techniques is champy technique.[22] The obsolute necessity of intraoperative MMF as an adjunct to internal fixation has also become controversial. [32]

Advantages of MMF includes,[3]

1. It allows reattachment of soft tissue
2. Stabilizes occlusion
3. Decrease incidence of complications

Disadvantages of MMF includes,[8]

1. Oral airway compromise
2. Poor nutrition
3. TMJ disorders
4. Patient dissatisfaction
5. Oral cleaning cannot be properly done due to closed mouth.

Contraindication of MMF includes,[3]

1. Epilepsy
2. Asthma
3. Psychiatric patient

Advantages of the rigid intraoral fixation as compared with closed reduction includes,[32]

1. Shorter MMF period (or) No MMF
2. Early mandibular movements
3. ↑ Patient satisfaction
4. ↓ hospital stay
5. Faster healing

ORIF with bone plates was first described by 'Schede' in 1888. Extraoral technique predominated until 1890, when 'luhr' introduced 'vitallium compression plates'[32] In early 1970s 'Schmoker' & Spiessl' developed 'dynamic compression plates' for a mandible which used eccentrically placed screws to generate compression. [32]

Miniplates are 'functionally stable fixation' unlike rigid fixation that prevents 'micromotion' of bony fragments under function.[3] Non-compression miniplates, decrease necrosis of fracture segments and produce "less stress shielding" effect. [3]

Today, Rigid internal fixation using, Non-compression plating systems has gained popularity.[8] Miniplates were widely used for past 20 years following principles by 'Michelet et al', "Champy et al'. [9]

'Michelet et al' Experimented with monocortical noncompression miniplates (1973).[32] 'Champy et al' showed superior mandibular border was subject to tension, splaying and inferior border was subject to compression.[32] 'Champy et al' used, 'Non rigid, non compression plates' with mono cortical screws and he proved that immobilization of bone fragments using rigid fixation was not always necessary.[1]

In mid 1970s, 'Niderdellmann et al' used 'lag screw' which generate fracture stability through compression without use of plates.[32] During 'lag screws' insertion, the proximal and distal bone segments are drilled with differing sized bits so that the screw slides through the proximal segment to posterior while gaining purchase of the distal segment. [32]

Preferred techniques for simple, non comminuted angle fracture includes,[32]

1. 'Champy technique' without arch bars - 31%
2. 'Champy technique' with arch bars - 20%
3. Tension band plate with bicortical plate - 13%
4. Dual miniplates - 10%
5. Locking screw plates - 7%
6. 3D plating (Square or rectangular plates) - 6%

Difficulties of champy's technique includes,[1]

Material factors:

1. Inaccurate centric placement of screws
2. Lack of rigidity
3. Trans oral angulation of screw placement
4. Screw hole drilling access

Patient factors:

1. Comminution of angle fracture
2. Lack of bone stock
3. Obliquity of fracture segments

Advantages of 'Locking Screw Plate' are,[32]

1. Unique screw configuration that posses threads for bone and plate.
2. This allows the screw to engage the plate and screw as an 'internal and external fixation'
3. Traditional screws essentially holdup the plate to the bone, whereas the locking screw anchors the plate in a manner that increase 3D stability.
4. By allowing the screw to separately engage the plate, perfect plate contour in unnecessary.

Original 'AO' Technique was placement of superior and inferior border compression plates for angle fractures and 'AO' modification technique includes,

Non compression tension plate at superior border, and compression plate at inferior border.[32]

Indications for Extra oral 2 miniplates fixation includes,[32]

1. Old fracture
2. Comminuted fracture
3. Infected fracture
4. Severely dislocated fracture of edentulous mandible

Indications for single miniplate Intraoral route includes,[32]

1. Non-comminuted fracture
2. Minimally displaced fracture
3. Non-complicated fracture

Best approach for angle fracture is based on,[32]

1. Severity of fracture
2. Location of fracture
3. Ability to visualize and reduce the fracture
4. Personnel experience of surgeon with the techniques

Surgical approaches of transbuccal, transoral techniques includes, incision made in oral mucosa during transoral approach and Incision made in oral mucosa and small incision in facial skin during transbuccal approach [2]

Advantages of Transbuccal (intraoral) approach includes,[7]

1. Minimal requirement to bend the plate.
2. Facilitation of placement of the plate in neutral midpoint area of mandible.
3. Significantly lower incidence of infections compared to trans oral technique, as in trans oral technique the fracture site is close to dentition.

Disadvantages of Transbuccal technique includes,[2]

1. Incidence of plate fracture with this technique double that of trans oral tech.
2. 'Screw loosening' due to mechanical failure at bone/ screw interface.
3. Theoretical risk of damage to facial nerve and causing facial scar, from 6mm facial skin incision.

Advantages of Trans oral technique includes,[3]

1. Eliminates extra oral hypertrophic cutaneous scars
2. Eliminates risk of marginal mandibular injury
3. Simultaneous observation of fractures during reduction and occlusion relationship is possible.

Disadvantages of Trans oral technique includes,[2]

1. More 'prone to breakage' because a greater degree of intra operative plate bending to adopt it complex contours of superior border of mandible. This stress weakens the metal.

2. 'Screw loosening' because the density of bone in superior aspect of mandible and alveolus is less than thickness of internal cortical plate of mandible where trans buccal plates are fixated.
3. 'Plate exposure' because, trans oral plate sits over external oblique ridge of mandible where soft tissue coverage is thin mucosa.

Advantages of locking miniplate systems (LMP) includes, [3]

1. 'Higher stability' than traditional miniplate
2. Requires 'less precise adaptation' of plate to underlying bone.
3. Decrease the chance of 'Screw stripping' with associated inflammation.

The design of 'Strut plate' is that '2' linear plates connected by reinforcing vertical struts plates provides, 'Greater resistance against gap formation at inferior border' with biting forces compared with when single plate at external oblique ridge.[4]

The percutanious fixation of non-comminuted mandible angle fractures with curved 2mm multi dimentional 'strut plate' carries low morbidity and infection rates that may prove to be comparable to the gold standard reconstruction plate.

ASIF: The association for study of internal fixation founded in 1958 under the original German Name AO. [1] This group asking questions regarding internal

fixation of fractures. The technique was bone healing using "dynamic rigid compression plates' to neutralize forces developed during functional loading.

Since 1970's two main school of thought have been advocated for ORIF. The AO/ASIF group advocated that 'total rigidity' and compression without inter fragmentary mobility is required to achieve primary bone healing during 'active use of mandible'.[10] The original AO technique was placement of superior and inferior compression plates for angle fracture.[32]

Original AO Technique includes,[10]

1. Use of non-deforming plates
2. Inter fragmentary compression
3. Instead of tension band, 2.7mm screws that could be applied separately as inter fragmentary 'lag screws' in beveled fracture.

The original AO technique was later modified using a single non-compression tension band plate at superior border and compression plate at inferior border, as it was realized that absolute / total rigidity was not necessary.[10]

Disadvantages of AO Technique includes,[10]

1. Inconvenience, difficult to manage certain fracture with rigidity.
2. This brings about post surgical malunion that might be impossible to resolve with 'MMF' especially if eccentric compression plates are used.

Different treatment modalities of mandibular angle fractures includes,[10]

1. Closed reduction + MMF with elastics for 40 days.
2. 2mm Miniplate + MMF for 15 days (Intraoral or extraoral)
3. 'AO' 2.4mm system of bone plate (Intraoral or extraoral) with immediate jaw mobility.
4. 'AO' 2.7mm system of bone plate (Intraoral or extraoral) with immediate jaw mobility

RECENT CONCEPTS:

'Ellis 2010 study' was performed for 12 years period and declared that single miniplates was the easiest to perform and, associated with lowest complication rate for fractures of angle of mandible. He accommodates, angle fractures with communion, bone loss or obliquity the choice is AO reconstruction plate which gives low infection rate or 'Curved lattice sturts' or grid miniplates. 'Ellis', 'Walker' showed, that using single miniplate is associated with lower complication rate than double miniplate in the fixation of angle fracture.[33]

The Bio degradable plates are resorbable plastic co-polymers, of Poly lactic acid, Poly glycolic acid and possess stiffness and sufficient strength to handle anatomic loads yet absorbed by the body.[14]

Advantages of Biodegradable plate systems includes,

1. Plate removal is not necessary .
2. After fracture healing, they will gradually disappear by degradation.[17]

Disadvantages of Biodegradable plate systems includes,[22]

1. Foreign body reaction was High
2. Easy breakage while adapting
3. Absence of self-tapping fractures

Titanium is material of choice for rigid fixation plates and screws due to high stiffness, strength.[14] Titanium plates have been used for more than two decades for internal rigid fixations of mandible fractures.[22] Titanium plates has advantages like high biocompatibility, ease of manipulations.

Recently, titanium particles were discovered in near tissue and surrounding lymph nodes, leading some clinician to recommended the removal of titanium materials after fracture healing.

Bone contact of 60 % or higher is required for satisfactory function of dental implants, and satisfactory fixation was achieved even at angle of mandible, because bone contact was 60% or higher[24].

Bone contact Ratio depended on the plate used and was lowest for 4 hole miniplates, with the 6-hole miniplates, a high bone contact ratio was seen. This is thought to have been result of the more stable fixation obtained by using a larger number of screws[24]. Researchers have reported that proper healing requires a maximum displacement at the fracture of less than 150μm.[14] We found that commercially available Titanium champy's miniplate resulted in fracture mobility below the set limit of '150μm' for all bite points.[17] New bone formation

was seen in titanium screws in all cases. Newly founded tissue was classified into 2 types includes,[24]

1. Continuous bone formation
2. Non continuous bone formation

Formation of new bone is defensive reaction of body to protect itself against the screw.[24] 'Yellow bone marrow' observed in bone surrounding the screw was thought to result of fatty degeneration of marrow.[24]

Glucocorticaids is effective in reducing post op nausea, pain, oedema and also suppress immune system including would healing.[5] Perioperative use of dexamethasone 'does not' significantly increase the risk of impaired wound healing in clinically uninfected mandibular fractures being treated surgically through intra oral approach with titanium miniplates. [5]

BIO MECHANICS:

Angle fractures with incisor loading will result in tensile forces at upper margin, compressive forces at lower margin. When molar loading is done, it will in result tensile forces at inferior border and compressive forces will occur in upper border. [26].

In the angle region only moments of flexion were found, increasing from the front teeth to a maximum of approximately 600N in the angle. An ideal line of osteosynthesis which corresponds to force of tension along 'linea obliqua' was determind. The mechanical properties of the osteosynthesis material should ensure that the induced forces to mandibular body are neutralized after application

of osteosynthesis material along this line.[27] The ability of single miniplate placed at superior border of mandible to "neutralized" functional forces and allow immediate active mobility is finally recognized by the AO/ASIF as a reliable means of providing functional stability of the fracture[30].

'Load Sharing' miniplates for simple, undisplaced angle fractures where less rigidity needed. 'Load bearing' miniplates for Complex, comminuted, atrophic edentulous, pathological, infected mandibular fractures, where increased rigidity needed[7].

More torsional movements are expected in the less rigid miniplates than DCP or reconstruction plates, therefore miniplates are not recommended for comminuted and infected fractures[3].

'Finite element analysis' methodology (FEA) is a powerful tool for computational modelling that is being widely used to predict the 'mechanical behavior' of complex biological structures such as bone[6]. 'FEA' is a valid, non-invasive method that provides useful results to predict different parameters of complex biomechanical behavior of human mandibles[6].

No difference in mechanical behavior within and among categories for incisal edge loading and there were differences noted within and among categories during "contra lateral molar loading" because of torsional forces"[15]. Bite forces applied close to fracture results in "negative bending movements" which gives zone of compression in alveolar region, zone of tension at lower

border.[17] 'Negative' bending movements are best resisted using a plate positioned as for 'caudal' in lower border as possible[15].

We conclude that for angle fractures the most important function of 2nd plate is not to resist the 'Negative bending movements' but to help the upper plate to resist the high 'Positive bending movements'. Thus positioning the second plate halfway up the height of mandible is most effective in reducing fracture mobility[15].

Maximum molar bite forces during first week post op have been reported to be between 90N and 130N[22]. Ellis et al have found that bite forces in acute postoperative period are much less than bite forces recorded later in the postoperative period[15]

The significant reduction of bite forces following fracture treatment of mandible might be explained by traumatic or operative trauma to masseter muscles or protective neuromuscular mechanisms of masticatory system when after bone fracture, muscle splinting components are activated or deactivated to take forces to damaged bone. Furthermore the patient's willingness to bite hard is also a major factor[27].

COMPLICATIONS:

Main reason for infection associated with rigid fixation in "failure to archive stability even after placement of plates and screws"[9] Added metal to lower border of mandible which increase possibility of infection, even through it gives

stability more than single plate. 'Non-Union' and 'Delayed Union' are usually are result of infection or condition that decrease blood supply.

Fractures of mandible frequently result in inferior alveolar nerve injury and altered neurosensory function[20]. This may be due to, primary injury to inferior alveolar nerve in the line of fracture, and due to manipulation and fixation of the fracture[20].

Studies indicate that in 85% of the cases, the inferior alveolar nerve Neuro sensory scores were unchanged or improved immediately after treatment. In 15% of the cases Inferior alveolar nerve neurosensory status was worse after treatment.[20]

Specifically, patients with fracture displaced greater than 5mm had 6 fold increased risk for neurosensory injury after the treatment compared with patients with fractures displaced 5mm or less[20].

Reports in the literature indicate that prevalence of post injury IAN injury ranges from 5.7% to 58.5%[20]. The prevalence of IAN injury in other literature after fracture treatment ranges from 0.4% to 66.7%[20]. Finally, compared with closed reduction with MMF, the patients undergoing ORIF had a 40 fold increased risk of worsening of IAN sensory score after treatment[20].

'Ellis et al' showed, higher complication rates using compression plates on both mandibular borders intraorally in comparision to champy technique. The

champy technique passed the lowest complications rates (0 to 2.5%). Intra oral application of 'larger plates' appears to increase complication rates,

The reason behind is,

i. Extensive degloving required for plate placement.
ii. Large plates are also more difficult to contour to the mandible, subsequent compression can generate 'Telescoping' and fracture malalignment.

In long bones fractures misalignment is less important but in mandible fracture misalignment destroys occlusal relationships which is the one of the therapeutic goals of mandible restoration following fracture.

Plate orientation monoplanar or biplanar does not appear to affect the complications rate. But plate orientation in biplanar orientation provides more stable fixation than monoplanar orientation which applied with monocortical or Biocortical technique.

'Ehrenfeld et al" in his prospective study concluded,[32]

1) MMF, open reduction, bone osteosynthesis - lowest complication rate
2) ORIF + AO Plate + Intra oral approach – Highest complication rate
3) ORIF + Miniplates + Intraoral approach - No complication

'Enhrenfeld et al' is only one who proposed the prospective and randomized studies involving ORIF of mandible fractures. His conclusion suggested that smaller non-compression plates lowered the complication rate.[32] It

has quantified that the severity of the fracture is more important factor in the development of complications than the type of treatment used.[10]

'Niederhagen et al' performed prospective study and concluded as, 127 complications occured using Traditional AO method and 41 Complications using Miniplates. Many surgeons still felt that miniplate fixations did not provide adequate stability and required MMF for additional security,[32] But additional of MMF with miniplates did not significantly alter complication rates. [32]

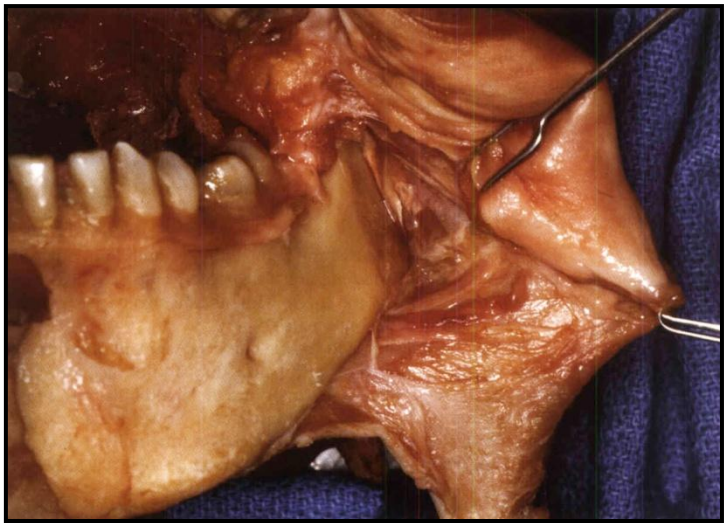
'Kroon et al', 'Chai et al' observed bony gaps along the inferior fracture border, and this fracture movement was thought to contribute to complications like infection, but additional placement of miniplate at lower boarder does not changing complication rates. [32]

Toma et al studied, no significant difference in complication rates was reported between transoral and extra oral routes for treatment of mandibular body, angle, ramus fractures. They found that when the surgeon shifted from intraoral approach to extra oral approach the complication rate increased. So pre operative decision should be made as to what approach should be used. [10] If the intraoral fixation has not been currently placed or is not sufficiently rigid, the rate of past surgical malocclusion may increase. [11]

The stability of a single superior border plate to allow for proper fracture healing has been shown in several studies for unilateral fracture through the angle of mandible. [21]

Fractures of angle of mandible are usually accessed via an intra oral mandibular anterior ramal incision or modified ward's incision. It allows relatively safe access to the entire facial surface of mandibular skeleton. One advantage of this approach is the ability to constantly assess the dental occlusion during surgery. The greatest benefit to the patient is the hidden intra oral scar. The approach is also relatively rapid and simple although access is limited in some regions, such as anterior border of ramus, retro molar trigone. Complications are few but include plate exposure, paraesthesia of tongue and lower lip.

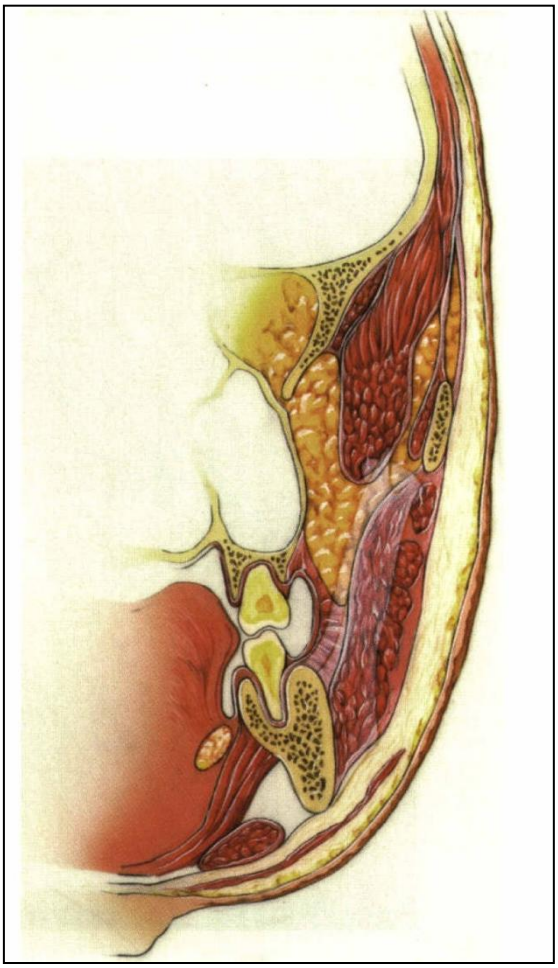
Facial Vessels



Facial artery and vein are usually not encountered during the manibular anterior ramal incision or modified ward's incision unless dissection through the periosteum occurs in the region of the mandibular antigonial notch. The facial artery arises from the external carotid artery in the carotid triangle of the neck. At or close to its origin, it is crossed by the posterior belly of the digastric muscle, the sylohyoid muscles, and hypoglossal nerve. In the submandibular triangle, the facial artery ascends deep to the submandibular gland, grooving its deep and

superior aspect, and then passes superficially to reach the inferior masseter muscle. It is covered on its superficial surface by skin and platysma muscle, and its pulsations can be felt at this location. The facial vein is the drainage of the angular and ultimately labial vessels. It is usually located more posterior and superficial to the artery. Of surgical significance, however is the fact that the facial artery and vein are close to the mandible in the region of the inferior border. The only structure that separates the vessels from the bone is the periosteum.

Buccal Fat Pad



The buccal fat pad consists of a main body and four extensions: buccal, pterygoid, pterygomandibular, temporal. The body is centrally positioned. The buccal extension lies superficially within the cheek, while the pterygoid,

pterygomandibular, and temporal extensions are more deeply situated. The buccal extention is the most superficial segment of the fat pad and imparts fullness to the cheek. It enters the cheek below the parotid duct and extends along the anterior border of the masseter as it desends into the mandibular retromolar region. It overlies the main portion of the buccinator muscle as it crosses the cheek. In the cheek, the fat pad is anterior to the ramus. Its caudal extention intra orally is on a plane tangential with the occlusal surface of the mandibular third molar. Its anterior limit is marked by facial vessels, which are in same plane as the buccal fat pad. The parotid duct lies superficial to the fat pad and then penetrates the fat pad and buccinators to enter the oral cavity opposite the second molar. The buccal extension of the fat pad is limited by the masseteric fascia. A deep extention of the masseteric fascia blends with the fascia along the lateral surface of the buccinator. This fascial layer lines the deep surface of the buccal fat that is in contact with the buccinators.

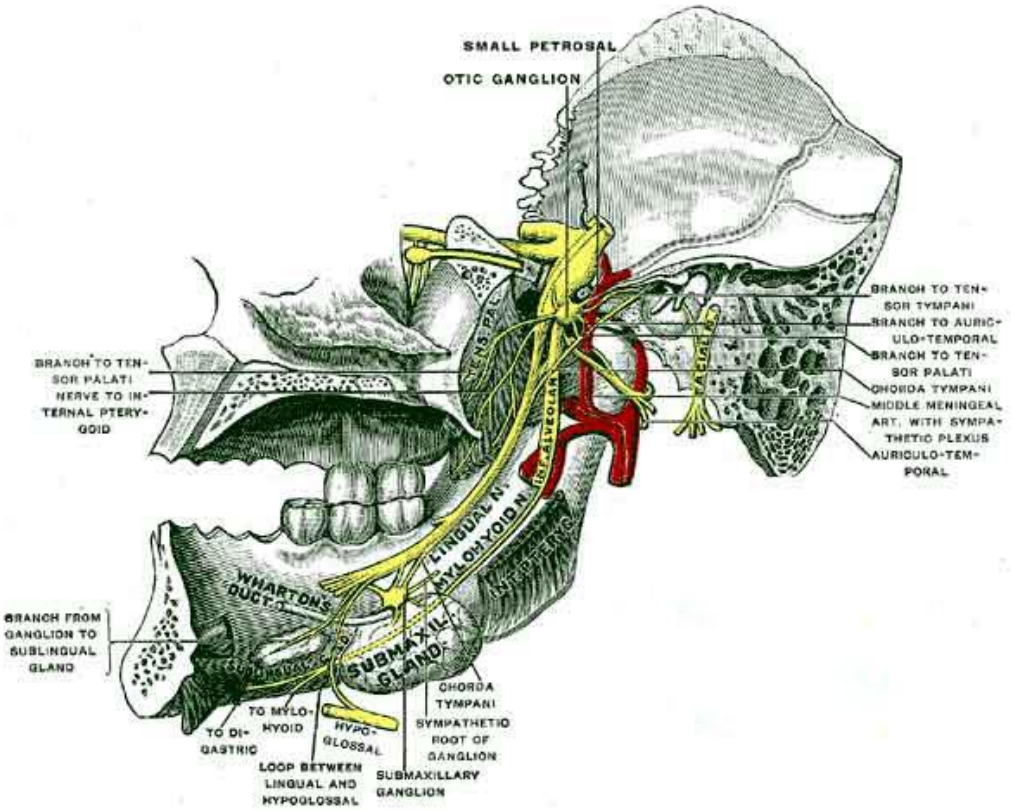
Lingual nerve

The lingual nerve is a terminal branch of the posterior division of the mandibular nerve. It enters the mouth between the medial pterygoid muscle and the ramus of mandible and then passes anteriorly under cover of the oral mucosa, just inferior to the third molar tooth. It is a sensory nerve to the anterior two-thirds of the tongue, the floor of the mouth and lingual gingiva. Moreover, it contains parasympathetic fibres from the facial nerve for the sublingual and submandibular glands. The lingual nerve runs anterior to the inferior alveolar nerve, so it is often anesthetised during inferior alveolar nerve block. Moreover, because of its

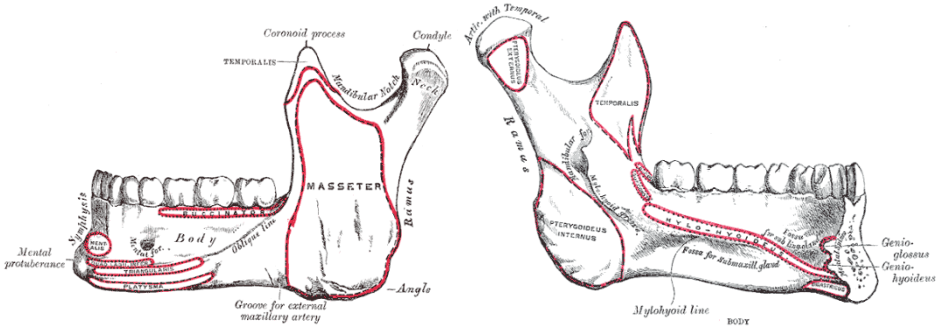
anatomical location, lingual nerve injury is possible during oral surgery, such as third molar extraction, mandibular trauma management.[33]

Relation of the lingual nerve with the third molar region shows frequency of lingual nerve injuries during oral surgical procedures varies between 0.6% and 2%. These injuries often result in anaesthesia, paresthesia or hypesthesia of the anterior part of the tongue and it can affected taste. However, permanent damage to the nerve is uncommon, and there is little detailed data on the spontaneous recovery rate.[33]

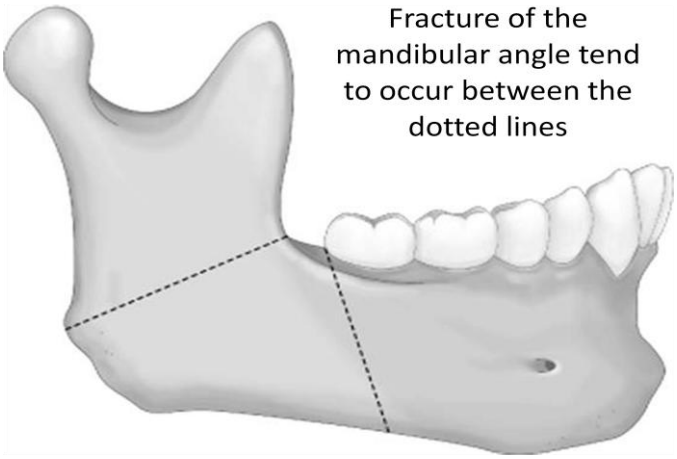
Anatomy of ascending ramus of mandible

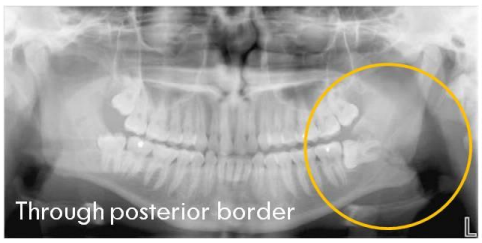


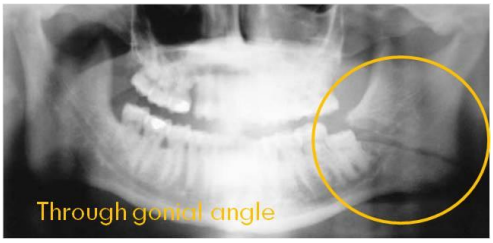
Muscles of mastication



Angle fracture: Any fracture distal to the second molar, extending from any point on the curve formed by the junction of the body and ramus in the retromolar area to any point on the curve formed by the inferior border of the body and posterior border of the ramus of the mandible.





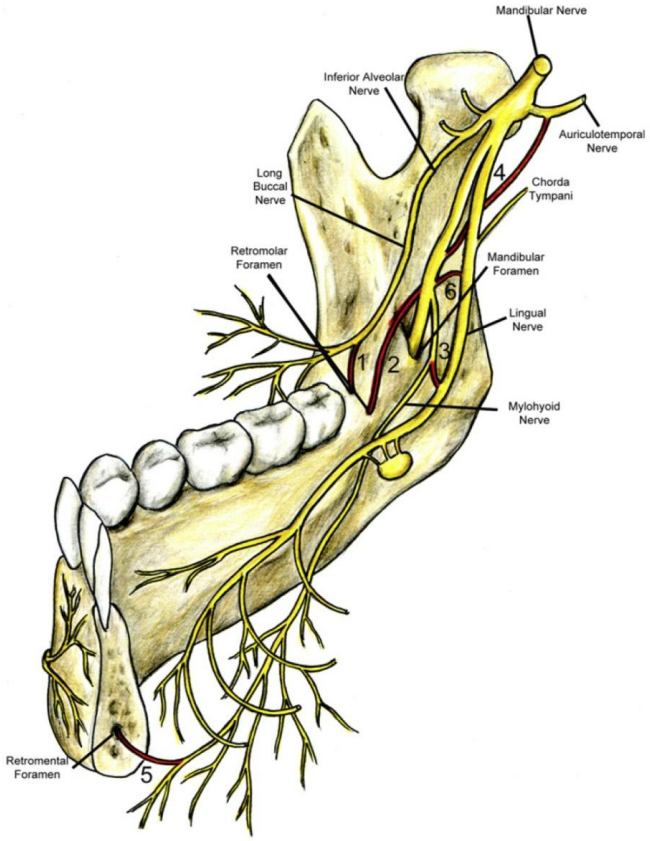


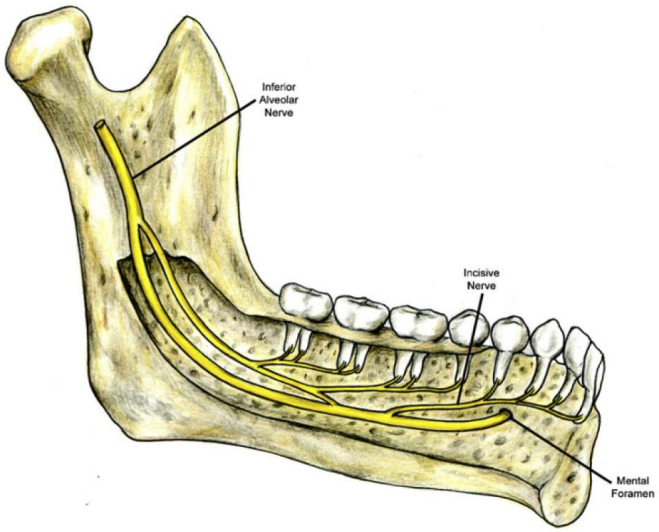
Fracture at the angle of the mandible - variations

Mandibular nerve

The mandibular nerve is the third and inferior division of the trigeminal nerve. Unlike the ophthalmic and maxillary divisions, which contain only afferent fibres, the mandibular division contains both afferent and efferent fibres. It runs from the trigeminal ganglion through the foramen ovale down towards the mandible in the region of the infra- temporal fossa giving off several branches. The main trunk divides into the nervus spinosus, a recurrent meningeal branch and the medial pterygoid nerve. Then, it divides into a small anterior and a large posterior trunk; the masseteric nerve, the deep temporal nerve, the long buccal nerve and the lateral pterygoid nerve originate from the former; from the posterior division the auriculotemporal nerve, the lingual nerve and the inferior alveolar nerve originate. The inferior alveolar nerve gives off the mylohyoid nerve before it enters the mandible through the mandibular foramen on the medial surface of the mandibular ramus and gives two terminal branches: the mental nerve and the incisive nerve.[33]

Anatomical variations of the mandibular nerve supply causes, the branching pattern of the nerve often account for failure to obtain adequate local anaesthesia in routine oral and dental procedures and for unexpected injury to branches of the nerve during oral/maxillofacial surgery.





Inferior alveolar nerve

The inferior alveolar nerve is the largest branch of the mandibular nerve. It runs into the infratemporal fossa and before entering the mandibular foramen originates a collateral branch, the mylohyoid nerve for the innervation of the mylohyoid and anterior belly of the digastric muscles. Then, it enters the mandibular foramen and runs with the inferior alveolar artery into the mandibular canal constituting the inferior alveolar neurovascular bundle (Fig. 1). In the canal, the nerve gives off two terminal branches: the mental nerve, a larger branch that emerges from the mental foramen and innervate the skin of the chin and the skin and the mucosa of the lower lip and the incisive nerve, a smaller branch, which continues to travel in the mandible and provides sensory innervation to the premolar, canine, incisor teeth and their associated gingiva.[33]

In this study 20 patients who reported to Department of oral & maxillofacial surgery, Tamilnadu Government Dental college & hospital, Chennai, with isolated (unilateral) fracture of angle of the mandible were selected based on the following criteria,

INCLUSION CRITERIA:

1. Simple & compound fracture (linear, non-comminuted) with or without occlusal derangement.
2. Isolated unilateral angle fractures.
3. All healthy individuals between 20-45 years of both sexes.
4. Dentulous patients.
5. Patients willing for a followup for atleast 3 months.

EXCLUSION CRITERIA:

1. Severely comminuted or infected fractures.
2. Edentulous patients.
3. Mandibular fractures other than fracture of the angle.
4. Associated midfacial fractures.
5. Medically compromised patients.

SAMPLE SIZE : 20 patients (10 in each group)

GROUP-I: In this group the patients were treated with a single (2mm) titanium miniplate 4 hole with gap and four 2x8mm titanium screws.

GROUP-II: In this group the patients were treated with single (2mm) titanium mini plates 6 hole with gap and six 2x8mm titanium screws.

All the patients were explained about the surgical procedures, its postoperative sequelae, and an informed consent both in English and the regional language was obtained before the commencement of study. The treatment plan, the surgical procedures and its consequences were documented, patients were fully informed of the possible advantages and disadvantages of treatment options.

Titanium miniplates 2mm four hole and six hole with gap, 2x8mm screws (of same size and form and from a single manufacturer) were used for all the patient's in both the groups. The aim, objective and the design of the study was approved by the Institutional ethical committee before the treatment was started.

Patients were clinically examined pre operatively for occlusion, (normal, mild discrepancy, no occlusion), and mouth opening (measured with graduated scale). Clinical photograph of occlusion both pre and postoperative were taken. Preoperatively as well as postoperatively the bite force was measured with "bite force measuring sensor" at molar region both in the affected and the unaffected side to assess the masticatory force in the fracture site. The bite forces were recorded digitally in kilograms in both the groups.

Intra operatively, adaptability of titanium plates on the contour of bone, access to retromolar trigone during last screw placement, intra operative time , stability of fragments after fixation, stability of plates after fixation were assessed. Post operative Orthopantomogram was taken to assess the fracture reduction, fixation, adaptability and stability of the miniplates. During the follow-up period the occlusion, mouth opening, presence or abscence of wound infection, wound dehiscence if any and neurosensory deficits were assessed.

Neurosensory deficits of mental nerve, inferior alveolar nerve, lingual nerve were assessed pre-operatively for anaesthesia, paraesthesia, tingling sensation, and normal sensation by light touch, one point discrimination and same neurosensory deficits assessed post operatively.

Armamentarium

GROUP I

Titanium 2mm 4 hole plate

GROUP II

Titanium 2mm 6 hole plate

SURGICAL PROCEDURE:

All the patients with isolated unilateral angle fracture of the mandible were treated with champy's miniplate osteosysnthesis was under local anesthesia. Erich's arch bars are placed and occlusion was achieved through Maxillomandibular fixation.

Fracture site was exposed via an intraoral incision along the anterior border of ramus in cases where the 3rd molar were retained. In cases where the need for the removal of the 3rd molar a modified ward's incision was placed to expose the fracture site. Care was taken while raising the mucoperiosteal flap on the lingual side to avoid damage to the lingual nerve.

The exposed fracture angle of the mandible was reduced to anatomical alignment and fixed by a single 2mm 4hole titanium mini plate with gap and four 2x8mm titanium screws in superior border along external oblique ridge in GROUP I patients and by single 2mm 6hole titanium miniplate with gap and six 2x8mm titanium screws in superior border in GROUP II patients.

The MMF was released temporarily to place the last screw caudally. The adaptability and the stability of the plate along the fracture line were assessed by clinical observation. Haemostasis was obtained and the wound was sutured with 3-0 vicryl.

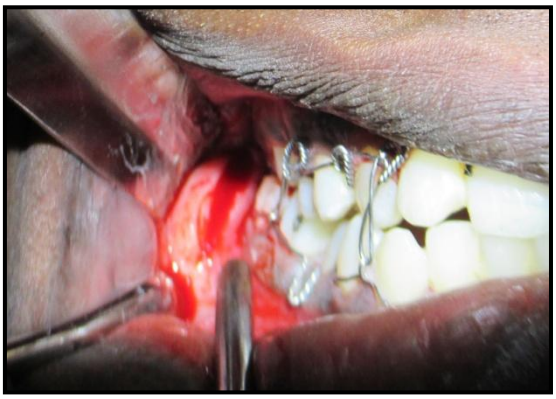
Both groups of patients were kept under postoperative MMF for period of two weeks and reviewed periodically. Pressure bandage was applied on the lateral aspect of angle in all patients, to substantially minimize the postoperative oedema.

All the patients were administered systemic antibiotics for 5 days. Post operative instructions were given on maintenance of oral hygiene using chlorhexidine mouthwash for 2 weeks. The patients were advised to take soft, preferably a semisolid diet. In all the cases the postoperative period was uneventful.

The entire clinical and radiological parameters were followed for 3 months at an interval of 1stweek, 3rdweek, 3months.

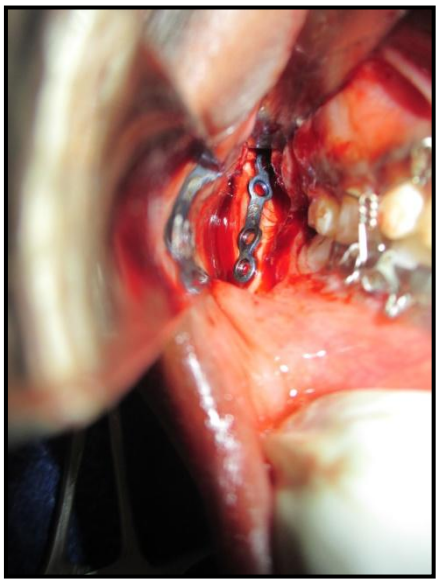
SURGICAL PROCEDURE (Group I)

1. Incision:



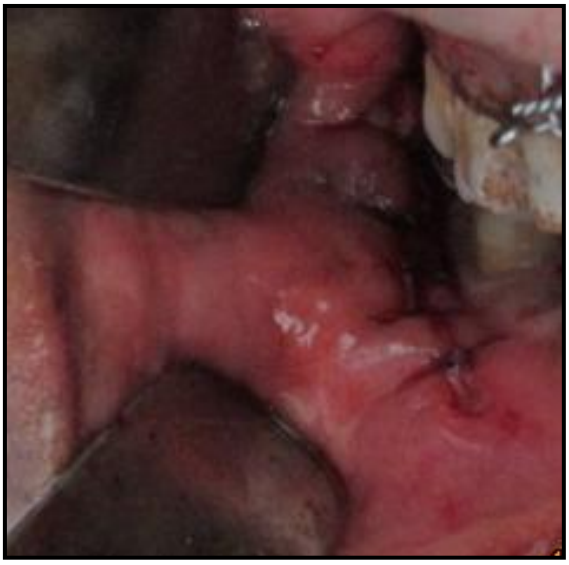
2. Exposure of fracture site & Reduction:

3. Adaptation of the titanium mini plates:



4. Fixation of the plates:

5. Wound Closure



SURGICAL PROCEDURE (Group II)

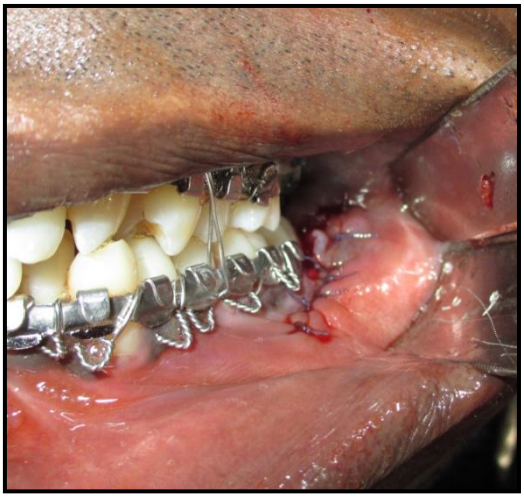
1. Incision:

2. Exposure of fracture site & Reduction:

3. Adaptation of the titanium mini plates:

4. Fixation of the plates:

5. Wound Closure



GROUP I

CASE SHEET - 1

Name : Mr. Bhoopalan

Age / sex : 21/M

Group : I

Chief complaint : Swelling of right side of face for past 6 days.

History of presenting illness : Road Traffic Accident

Past medical / surgical history : Not Relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis : Fracture right side of angle of mandible

Treatment done : ORIF with 4 hole titanium plate

Complications if any : No

CASE SHEET - 2

Name **:** Mr. Sathish

Age / sex **:** 25/M

Group **:** I

Chief complaint **:** Swelling on right side of face for past 10 days

History of presenting illness : Road traffic accident

Past medical / surgical history : Not relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture right side angle of mandible

Treatment done **:** ORIF with 4 hole titanium plate

Complications if any : No

CASE SHEET - 3

Name **:** Mr. Selvakumar

Age / sex **:** 24/M

Group **:** I

Chief complaint **:** Swelling on right side of face for past 7days

History of presenting illness : Road traffic accident

Past medical / surgical history : Not Relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture right angle of mandible.

Treatment done **:** ORIF with 4 hole titanium plate

Complications if any : No

CASE SHEET - 4

Name **:** Mr. Balaji

Age / sex **:** 43/M

Group **:** I

Chief complaint **:** Swelling of right side face for past 6 days.

History of presenting illness : Road traffic accident

Past medical / surgical history : Not Relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture right side angle of mandible

Treatment done **:** ORIF with 4 hole titanium plate

Complications if any : No

CASE SHEET - 5

Name **:** Mr. Prem kumar

Age / sex **:** 40/m

Group **:** I

Chief complaint **:** inability to close his mouth, swelling in right side of face for 6 days.

History of presenting illness : Road traffic accidents

Past medical / surgical history : Not relavant.

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	no

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture right angle of mandible

Treatment done **:** ORIF with 4 hole titanium plate

Complications if any : Plate exposure

CASE SHEET - 6

Name **:** Mr.Ravi

Age / sex **:** 40/m

Group **:** I

Chief complaint **:** inability to close his mouth, swelling in right side of face for 8 days.

History of presenting illness : Road traffic accidents

Past medical / surgical history : Not relavant.

Local examination:

Extra Oral :

Step deformity	-	yes
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture left angle of mandible

Treatment done **:** ORIF with 4 hole titanium plate

Complications if any : Plate exposure

CASE SHEET - 7

Name **:** Mr.Santha kumar

Age / sex **:** 26/M

Group **:** I

Chief complaint **:** Swelling on right side of face for past 11 days

History of presenting illness : Road traffic accident

Past medical / surgical history : Not relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture left side angle of mandible

Treatment done **:** ORIF with 4 hole titanium plate

Complications if any : No

CASE SHEET - 8

Name **:** Mr. Bhoopesh

Age / sex **:** 20/M

Group **:** I

Chief complaint **:** Swelling on right side of face for past 7days

History of presenting illness : Road traffic accident

Past medical / surgical history : Not Relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture right angle of mandible.

Treatment done **:** ORIF with 4 hole titanium plate

Complications if any : No

CASE SHEET - 9

Name : MrGiri

Age / sex : **23**/M

Group : I

Chief complaint : Swelling of left side face for past 6 days.

History of presenting illness : Road traffic accident

Past medical / surgical history : Not Relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis : Fracture left side angle of mandible

Treatment done : ORIF with 4 hole titanium plate

Complications if any : No

CASE SHEET - 10

Name **:** Mr Sarala

Age / sex **:** 21/M

Group **:** I

Chief complaint **:** Swelling of left side of face for past 9 days.

History of presenting illness : Road Traffic Accident

Past medical / surgical history : Not Relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture left side of angle of mandible

Treatment done **:** ORIF with 4 hole titanium plate

Complications if any : No

GROUP II

CASE SHEET - 1

Name **:** Mr. Kalai selvan

Age / sex **:** 33/m

Group **:** II

Chief complaint **:** Swelling on the left side of face far past one week

History of presenting illness : Accidentally hit by neighbours

Past medical / surgical history : not relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	resricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	yes
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture left side of angle of mandible.

Treatment done **:** ORIF with 6 hole titanium plate

Complications if any: Wound infection around 2 week post op

CASE SHEET - 2

Name **:** Mr. Veeran

Age / sex **:** 45/m

Group **:** II

Chief complaint **:** Swelling in left side of face for past 6 days.

History of presenting illness: Road traffic accidents

Past medical / surgical history: Not relavant

Local examination:

Extra Oral :

Step deformity	-	present
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture of left side angle of mandible

Treatment done **:** ORIF with 6 hole titanium plate

Complications if any: No

CASE SHEET - 3

Name : Mr. Joseph

Age / sex : 32/M

Group : II

Chief complaint: Pain and swelling in the left side of face for past 5 days

History of presenting illness : Road traffic accident

Past medical / surgical history : Not Relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis : Fracture left angle of mandible

Treatment Group : II

Treatment done : ORIF with 6 hole titanium plate

Complications if any : wound infection post op 1st month

CASE SHEET - 4

Name **:** Mr. Moses

Age / sex **:** 25/M

Group **:** II

Chief complaint **:** Swelling in left side of the lower face past 8 days**.**

History of presenting illness : Self fall from the bike.

Past medical / surgical history : not relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	yes
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture of left angle of mandible

Treatment done **:** ORIF with 6 hole titanium plate

Complications if any : No

CASE SHEET - 5

Name : Mrs. Devi

Age / sex : 35 / F

Group : II

Chief complaint : Swelling of right side of face for past 5 days

History of presenting illness : Road traffic accident

Past medical / surgical history : not relavant

Local examination:

Extra Oral :

Step deformity	-	present
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis : Fracture of right side angle of mandible

Treatment done : ORIF with 6 hole titanium plate

Complications if any : Wound infection post op 2nd month

CASE SHEET - 6

Name **:** Mr. Marimuthau

Age / sex **:** 33/m

Group **:** II

Chief complaint **:** Swelling on the left side of face far past one week

History of presenting illness : Accidentally hit by neighbours

Past medical / surgical history : not relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	resricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	yes
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture left side of angle of mandible.

Treatment done **:** ORIF with 6 hole titanium plate

Complications if any : No

CASE SHEET - 7

Name **:** Mr Narayana moorthy

Age / sex **:** **43** /M

Group **:** II

Chief complaint **:** Swelling in right side of the lower face past 8 days**.**

History of presenting illness : Self fall from the bike.

Past medical / surgical history : not relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	yes
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture of right angle of mandible

Treatment done **:** ORIF with 6 hole titanium plate

Complications if any : No

CASE SHEET - 8

Name **:** Mr Santhosh

Age / sex **:** **2**5/m

Group **:** II

Chief complaint **:** Swelling in right side of face for past 6 days.

History of presenting illness: Road traffic accidents

Past medical / surgical history: Not relavant

Local examination:

Extra Oral :

Step deformity	-	present
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture of right side angle of mandible

Treatment done **:** ORIF with 6 hole titanium plate

Complications if any: No

CASE SHEET - 9

Name : Mr. Thangaraj

Age / sex : 39 / F

Group : II

Chief complaint : Swelling of right side of face for past 5 days

History of presenting illness : Road traffic accident

Past medical / surgical history : not relavant

Local examination:

Extra Oral :

Step deformity	-	present
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis : Fracture of right side angle of mandible

Treatment done : ORIF with 6 hole titanium plate

Complications if any : No

CASE SHEET - 10

Name **:** Mr. Vigneahvaran

Age / sex **:** 32/M

Group **:** II

Chief complaint: Pain and swelling in the right side of face for past 5 days

History of presenting illness : Road traffic accident

Past medical / surgical history : Not Relavant

Local examination:

Extra Oral :

Step deformity	-	no
Condylar movements	-	palpable
Mouth opening	-	restricted
Tenderness on palpation	-	present

Intra oral :

Occlusion	-	deranged
Compound fracture	-	present
Teeth in line of fracture	-	yes

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis **:** Fracture right angle of mandible

Treatment done **:** ORIF with 6 hole titanium plate

Complications if any : No

CASE 1

CASE REPORT - GROUP I

Preoperative **Postoperative**

Frontal View

Occlusal View

IMF

Pre op OPG

Reduction & Fixation

Post Op 1 Week OPG

Post Op 3 Weeks OPG

Post Op 3 Months OPG

CASE 2

CASE REPORT - GROUP I

Preoperative **Postoperative**

Frontal View

Occlusal View

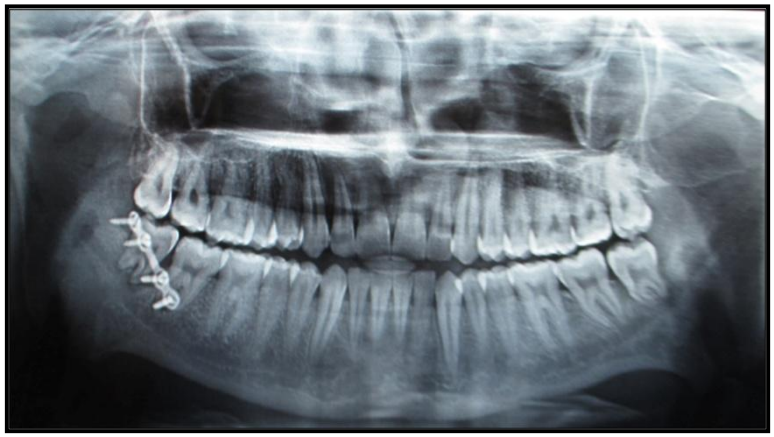
IMF

Pre-op OPG

Reduction & Fixation

Post Op 1 Week OPG

Post Op 3 weeks OPG



Post Op 3 Months OPG

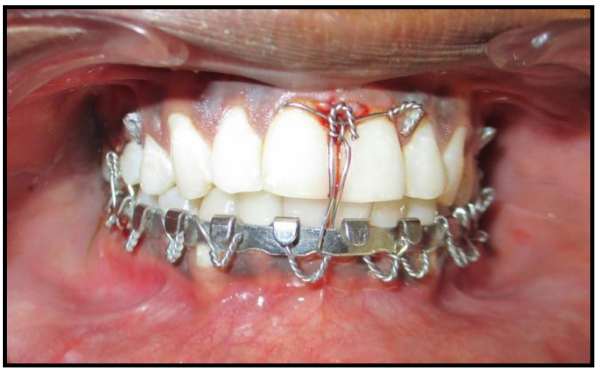
CASE 3

CASE REPORT - GROUP I

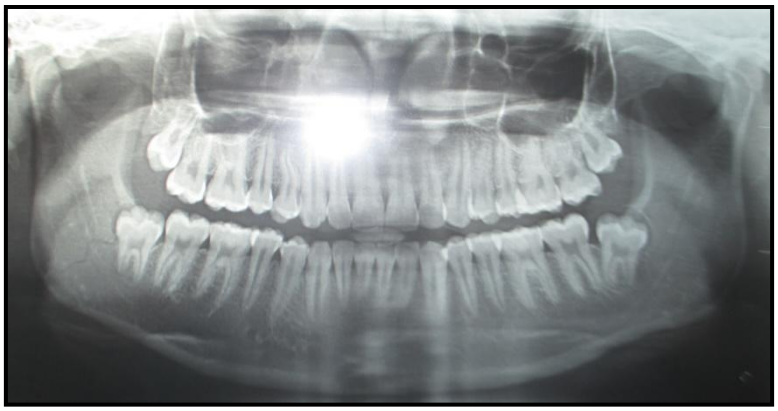
Preoperative **Postoperative**

Frontal View

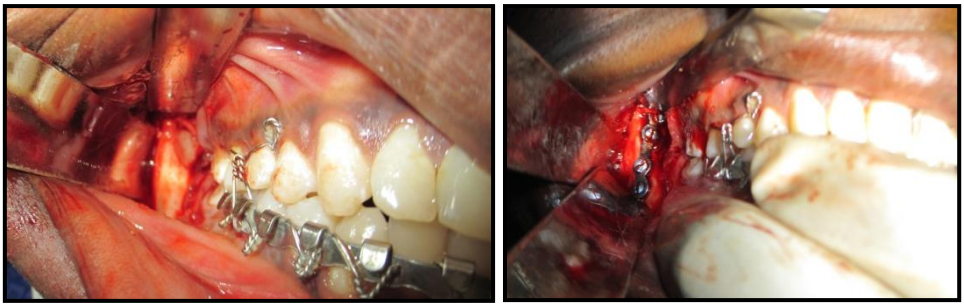
Occlusal View



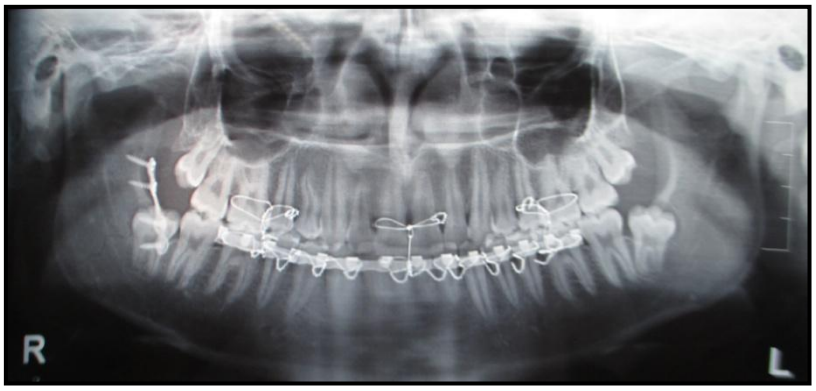
IMF



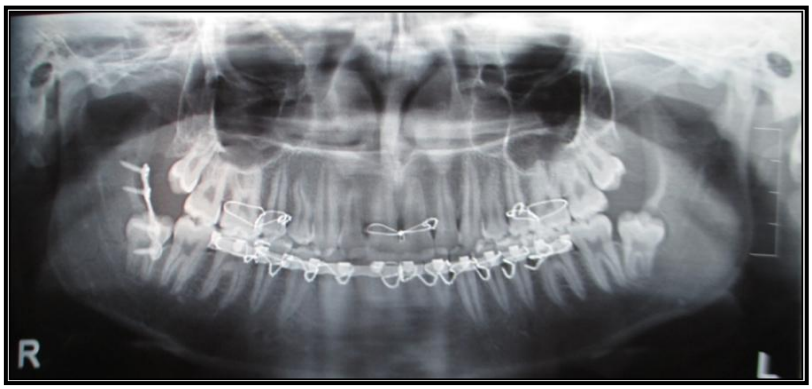
Pre Op OPG



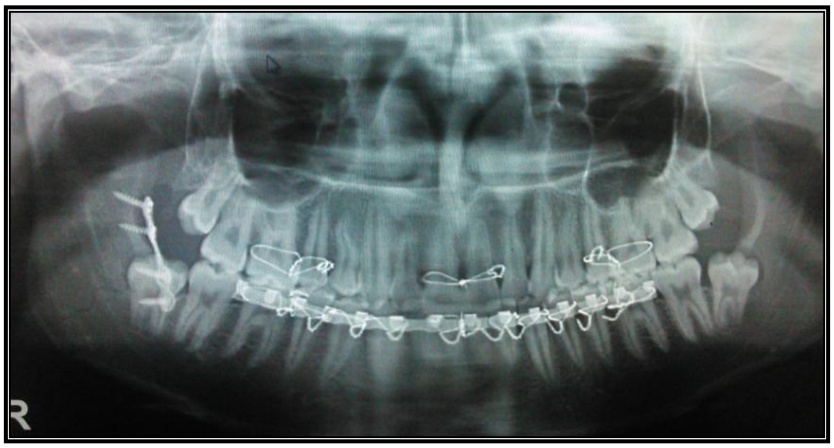
Reduction & Fixation



Post-op 1 week OPG



Post-op 3 weeks OPG



Post-op OPG 3 Months

CASE 4

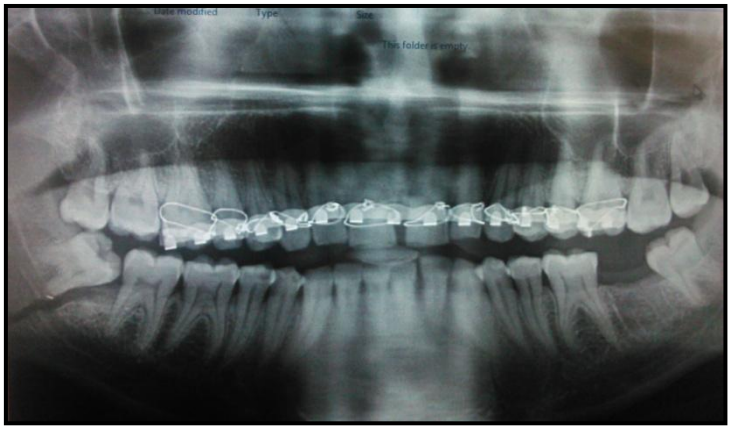
CASE REPORT - GROUP I

Preoperative **Postoperative**

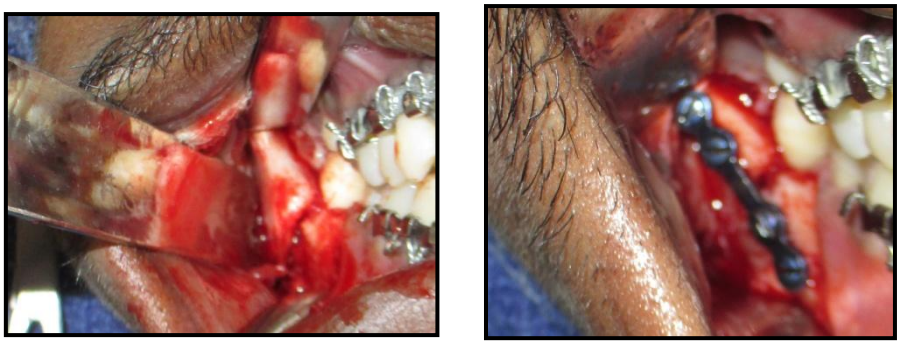
Frontal View

Occlusal View

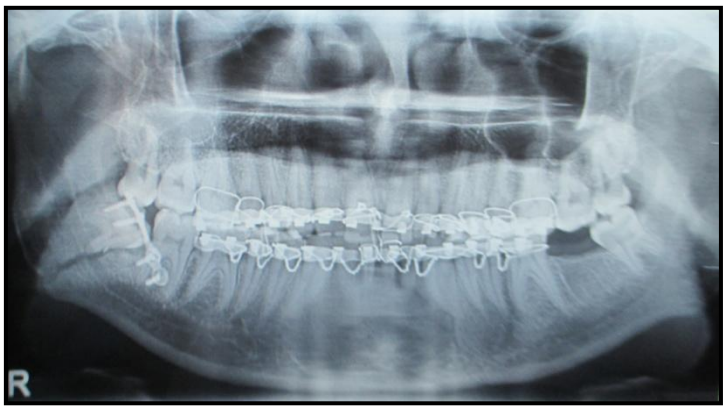
IMF



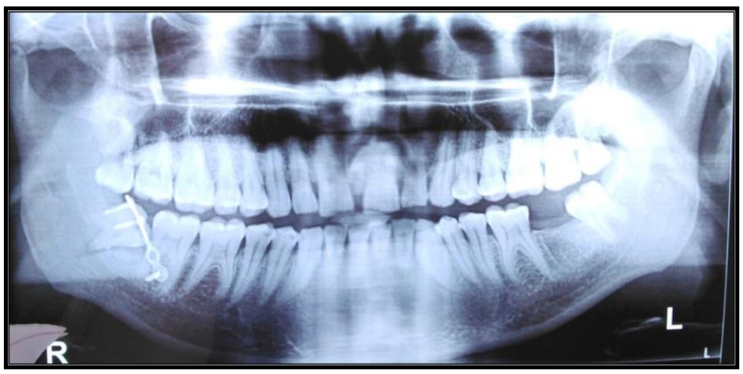
Pre-op OPG



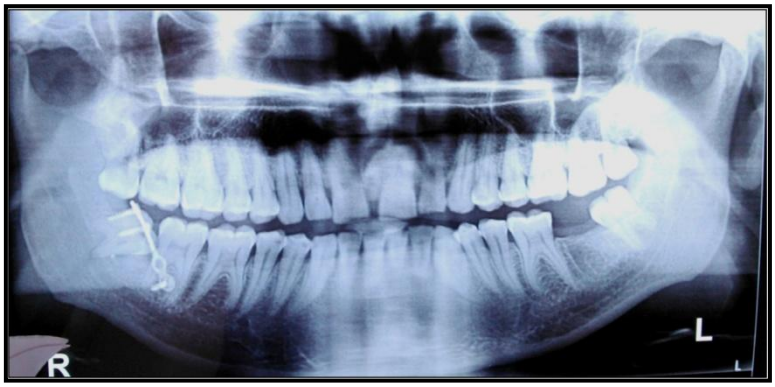
Reduction & Fixation



Post-op OPG 1 week



Post-op 3 weeks OPG



Post-op 3 Months OPG

CASE -5

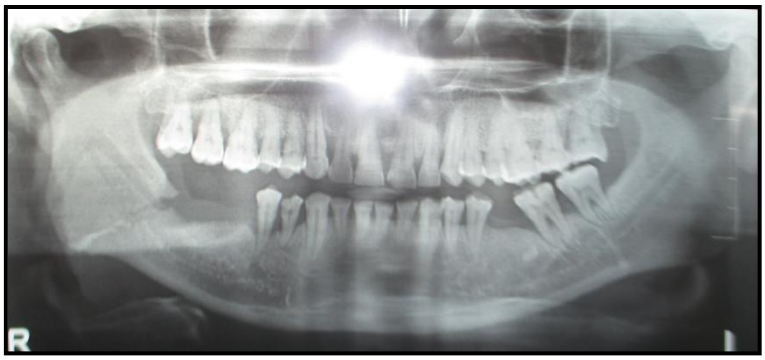
CASE REPORT - GROUP I

Preoperative **Postoperative**

Frontal View

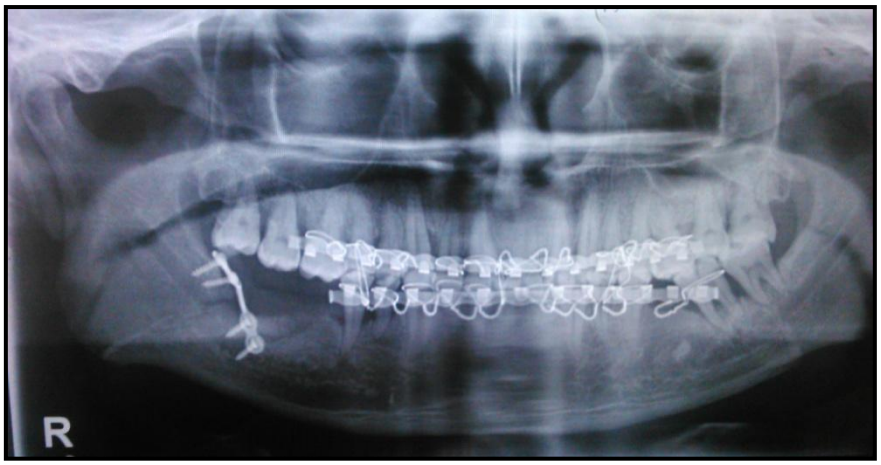
Occlusal View

IMF



Pre-op OPG

Reduction & Fixation



Post-op 1 week OPG

Post-op 3 weeks plate exposure

CASE 1

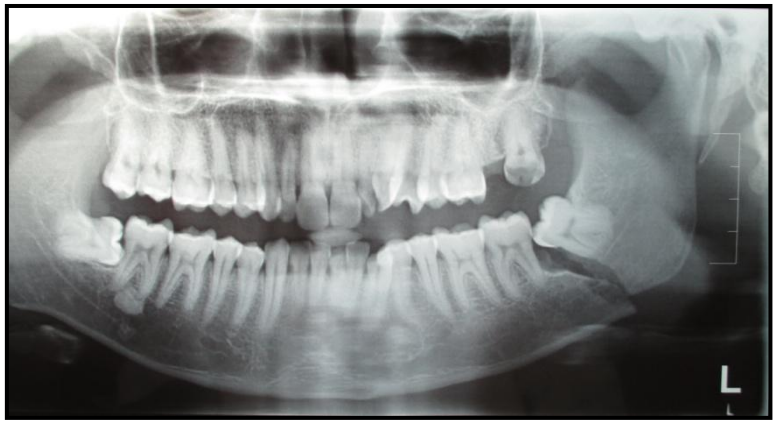
CASE REPORT - GROUP II

Preoperative **Postoperative**

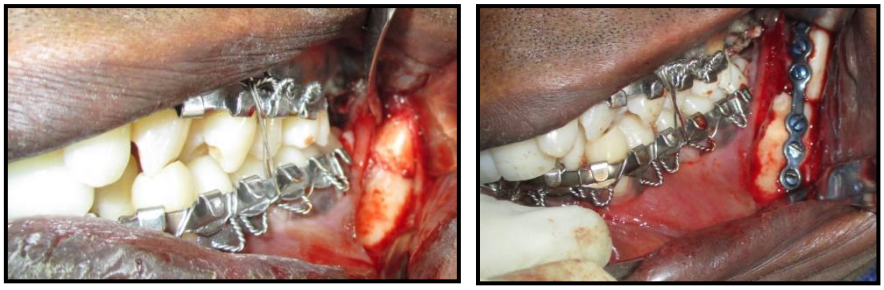
Frontal View

Occlusal View

IMF



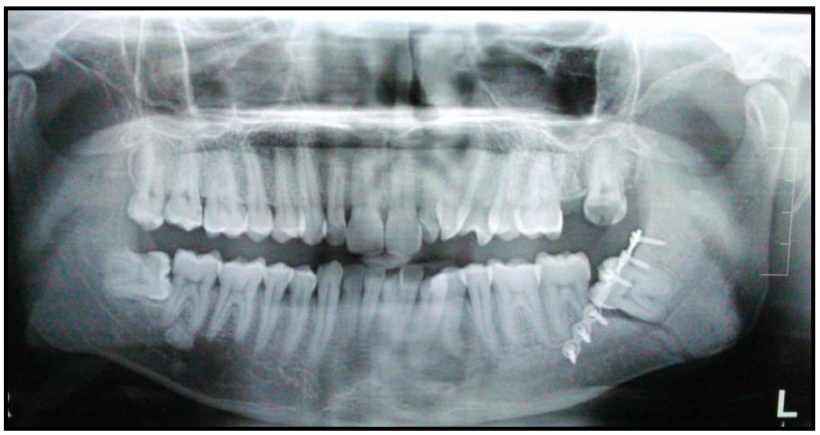
Pre-op OPG



Reduction & Fixation

Post-op 1 week OPG

Post-op 3 weeks OPG



Post-op 3 Months OPG

CASE 2

CASE REPORT - GROUP II

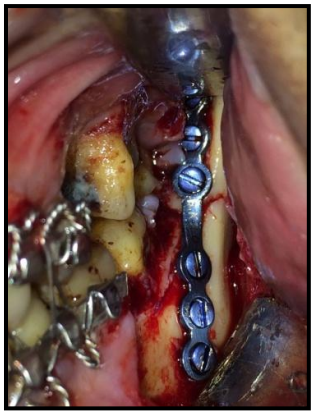
Preoperative **Postoperative**

Frontal View

Occlusal View

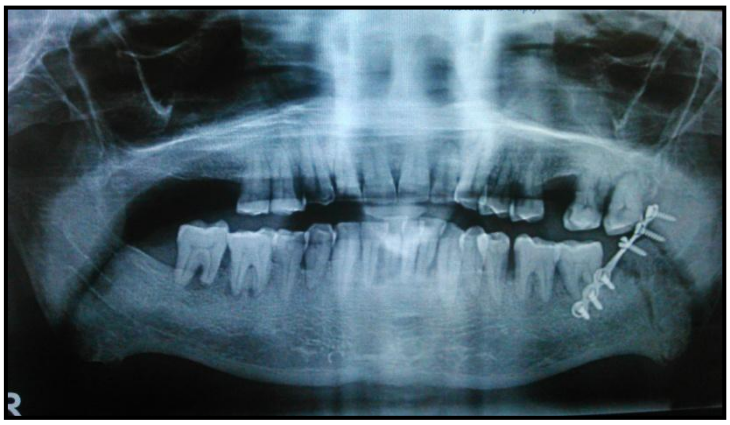
IMF

Pre-op OPG

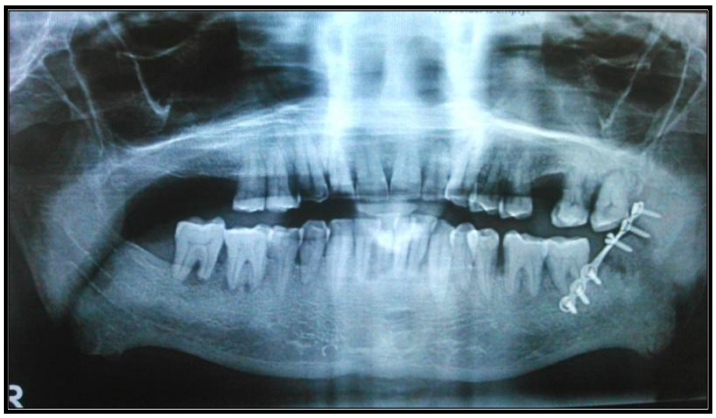


Reduction & Fixation

Post-op 1 Week OPG



Post-op 3 Weeks OPG



Post-op 3 Months OPG

CASE 3

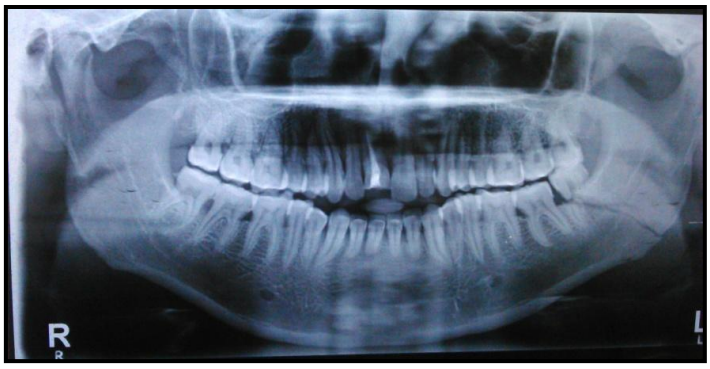
CASE REPORT - GROUP II

Preoperative **Postoperative**

Frontal View

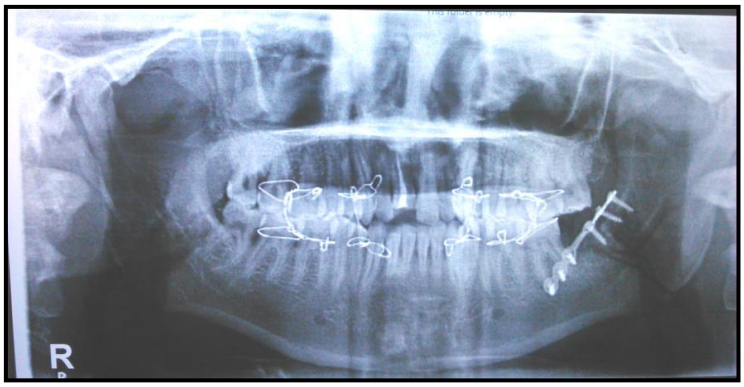
Occlusal View

IMF

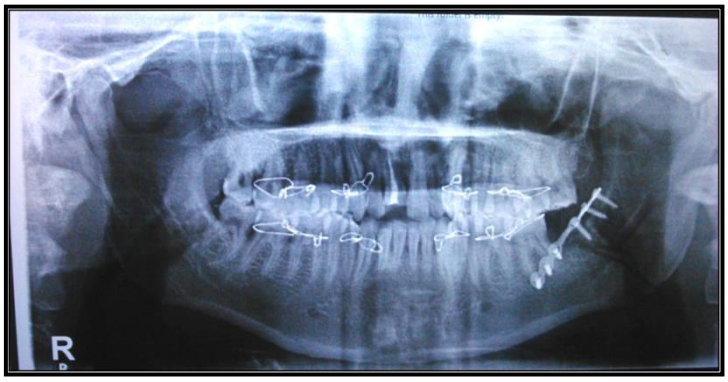


Pre-op OPG

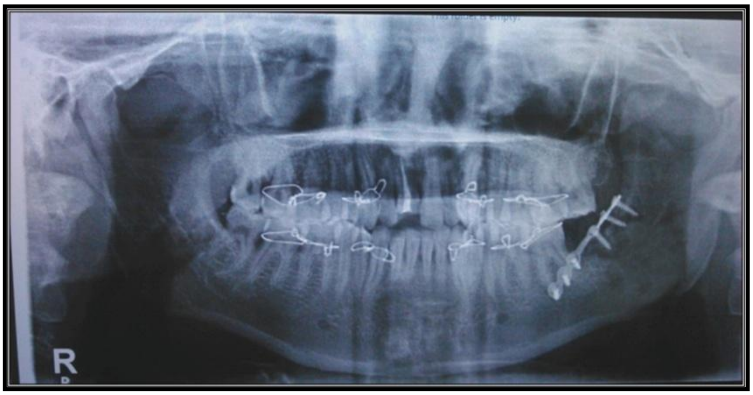
Reduction & Fixation



Post-op 1 week OPG



Post-op 3 weeks OPG



Post-op 3 Months OPG

CASE 4

CASE REPORT - GROUP II

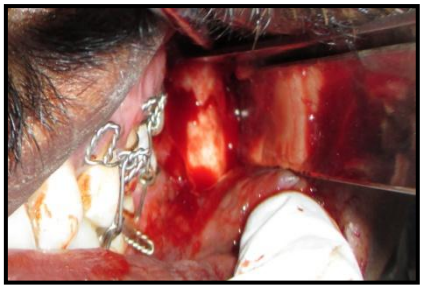
Preoperative **Postoperative**

Frontal View

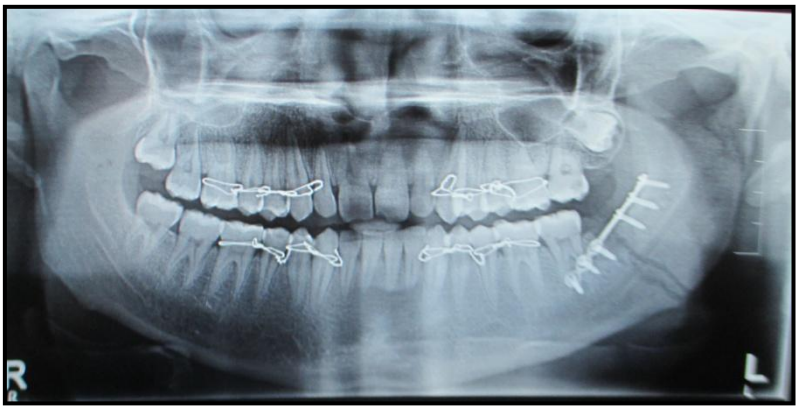
Occlusal View

IMF

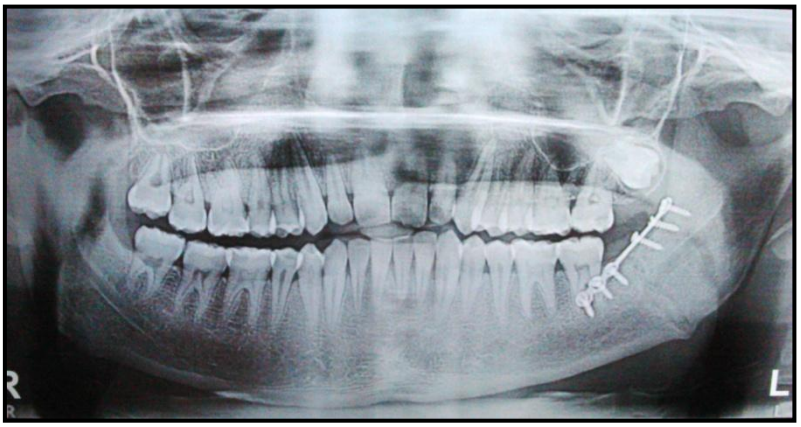
Pre-op OPG



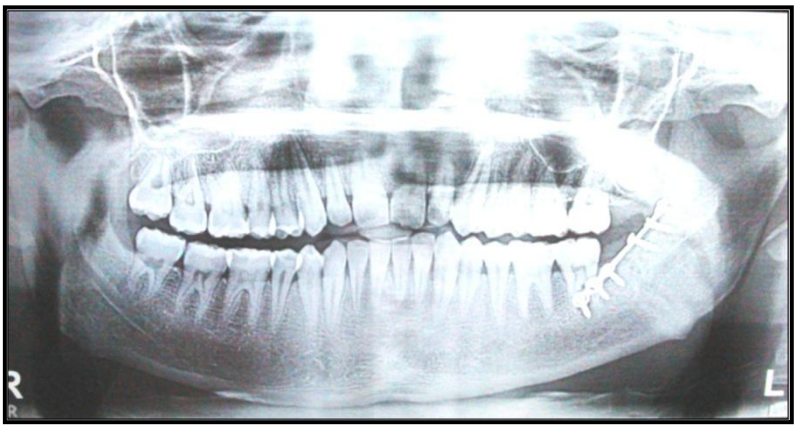
Reduction & Fixation



Post-op 1 Week OPG



Post-op 3 Weeks OPG



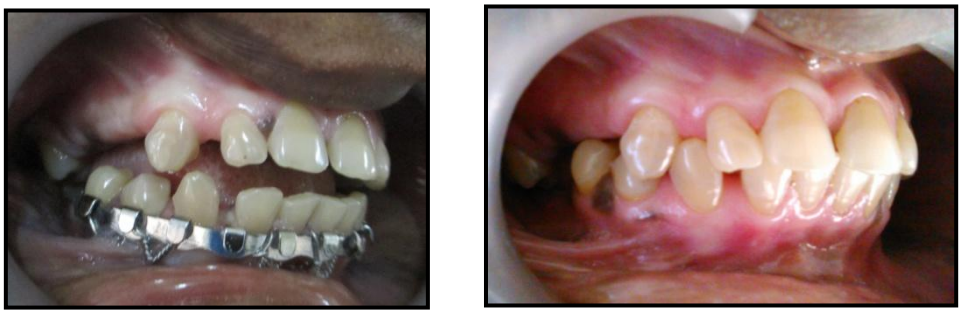
Post-op 3 Months OPG

CASE 5

CASE REPORT - GROUP II

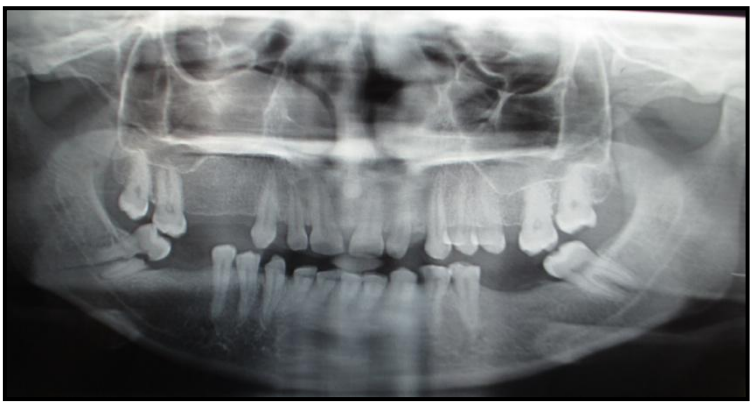
Preoperative **Postoperative**

Frontal View

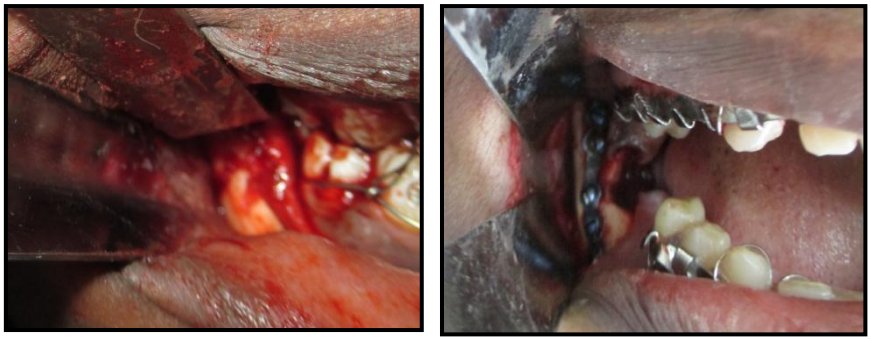


Occlusal View

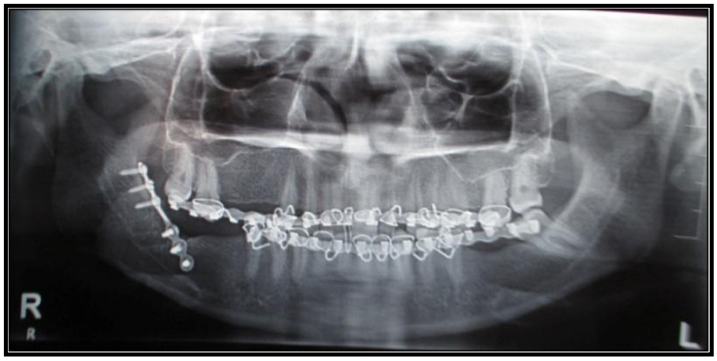
IMF



Pre-op OPG

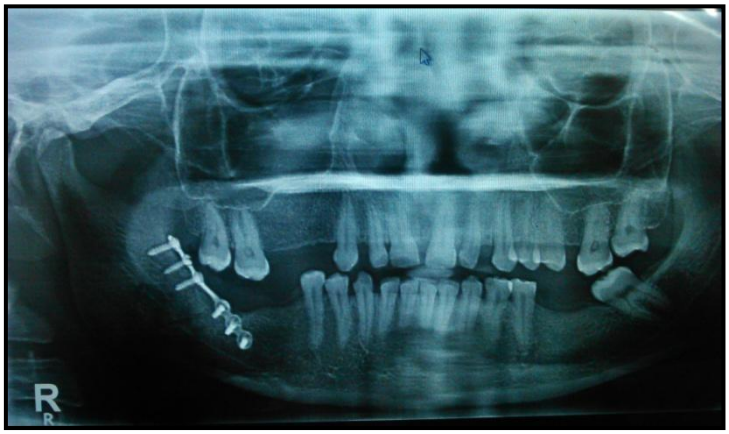


Reduction & Fixation



Post-op 1 week OPG

Post-op 3 weeks OPG



Post-op 3 Months OPG

Twenty patients with isolated fracture angle of the mandible who reported to Department of Oral & Maxillofacial surgery, Tamilnadu. Govt. Dental College & Hospital, were included in the study. The patients were divided into two group each group containing 10 patients. Majority of the patients were male constituting nearly 90%. In 80% of cases the angle fracture was on the right side, the post traumatic swelling was present in 70% of cases. The etiology of trauma was road traffic accidents in 19 patients and assault in one case. Only isolated angle fractures cases were selected for this study excluding, cases with any associated other mandibular fractures and / or middle third facial fractures.

Inability to open the mouth, swelling, deranged occlusion, step deformity, and mobility of segments were the chief complaints in all the patients who reported to the department. The angle fracture was minimally displaced in 70% of the patients and undisplaced in 30% of the patients. Third molar was involved in 50% of cases and required extraction of the tooth due to fracture of the crown with pulp exposure and mobile tooth. The parameters assessed both pre & post operatively were,

1. Mouth opening,
2. Occlusion,
3. Bite force on molar region,
4. Neurosensory deficit such as paraesthesia.

-Intra operatively

1. Intra operative time,

2. Stability of fragments,

3. Access to retro molar trigone during last screw placement.

4. Adaptability of the titanium mini plates,

The pre operative mouth opening in group I patients ranges from 14mm to 28 mm and the post operative mouth opening in group I patients ranges from 35mm to 53mm. In group II patients the pre operative mouth opening ranges from 13mm to 28mm and the post operative mouth opening ranges 35mm to 46mm. In all these patients it is observed that there is a gradual improvement in the mouth opening after open reduction with internal fixation with a follow up period of 3 months.

The bite force measured pre operatively in group I patient in affected side was ranges from 0.4 kg to 11.4kg and in the unaffected side 1kg to 12kg and the bite force post operatively in group I patient in the affected side ranges from 28kg to 43kg and in the unaffected side was 37kg to 58kg. In group II patients the bite force in the affected side pre operatively ranges 1kg to 11kg and in the unaffected side1kg to 10kg. Post operatively the bite force in the affected side after a follow up period of 3 months ranges from 34kg to 52kg and in the unaffected side it ranges from 38 to 54kg. The above values clinically does prove that there is a significant improvement in the masticatory efficiency of the individual after the surgical management.

Neurosensory deficits such as paraesthesia of lower lip was present in 1 patients in group I pre operatively and 7 patients in group II. All these patients were advised methylcobalamine during the post operative period. At the end of

the 3rd month, both group-I and group –II patients showed considerable improvement, with no neurosensory deficits. Adaptability and stability of the titanium mini plates in both the groups were assessed clinically and with the aid of OPG by visualizing the interface between the bone contour and the plates, and the interfragmentary approximation. Care taken to adapt the titanium plates to the angle of the mandible proved to yield a good results in the stability of the fragments. Stability of fragments was also assessed intra operatively by manually checking for any interfragmentary mobility of the segments after internal fixation. Clinically and radiologically it has been found that the stability of the fractured fragments has improved well after open reduction with internal fixation.

Intra operative time was assessed from the begining of the incision till the last suture placed. The intra operative time in group I patients ranges from 51 minutes to 59 minutes, in group II patients it was 57 minutes to 66 minutes. The intra operative time was found to increase in patients with displaced angle fracture, where considerable time was taken to reduce the fracture to an anatomical alignment.

The accessibility to the retro molar trigone was critically evaluated in both the groups during the surgical procedure. It has been observed interestingly that there was difficulty in group-II patients since the six hole with gap was extending caudally. The intermaxillary fixation was released and with the jaw in partial open mouth position the last two screws were placed. In four hole with gap titanium mini plate no such difficulty were encountered.

Occlusion was assessed pre & post operatively. In group I patients there was a mild discrepancy in occlusion in 8 patients pre operatively and post operatively there was a normal occlusion achieved in all 10 patients. In group II patients there was a mild discrepancy in occlusion in 9 patients and a normal occlusion in all patients was achieved post operatively.

There was a wound infection pre operatively in one patient in group I and in 3 patients in group II. Post operatively there was wound infection in 2 cases in group I and in only one case in group II. All the patients in both the groups were treated with appropriate antibiotics to control the wound infection. The post operative period was uneventful in all the cases.

COMPLICATIONS

PLATE EXPOSURE

Group I

WOUND INFECTION

Group II

TABLE

GROUP I

Cases	Types of fracture	Etiology	3rd molar involved	3rd molar removed (or) Tooth Retained	Treatment Done	Mouth Opening		Complications
						Pre-op	Post-op 3rd month	
1	Fracture R .angle	RTA	no	No tooth involved	ORIF with 4 Hole	16	35	Yes
2	Fracture R.angle	RTA	Yes	Retained	ORIF with 4 Hole	15	35	No
3	Fracture R.angle	RTA	Yes	Retained	ORIF with 4 Hole	28	50	No
4	Fracture R. angle	RTA	Yes	Retained	ORIF with 4 Hole	20	50	No
5	Fracture R. angle	RTA	Yes	Retained	ORIF with 4 Hole	28	45	No
6	Fracture L angle	RTA	Yes	Retained	ORIF with 4 Hole	20	40	No
7	Fracture R angle	Assault	Yes	Retained	ORIF with 4 Hole	18	53	No
8	Fracture L angle	RTA	Yes	Extracted	ORIF with 4 Hole	27	42	No
9	Fracture R.angle	RTA	Yes	Retained	ORIF with 4 Hole	14	45	No
10	Fracture R. angle	RTA	Yes	Retained	ORIF with 4 Hole	25	40	No

TABLE

GROUP II

Cases	**Types of fracture**	**Etiology**	**3rd molar involved**	**3rd molar removed (or) Tooth Retained**	**Treatment Done**	**Mouth Opening**		**Complications**
						Pre-op	Post-op	
1	Fracutre L. angle	RTA	Yes	Retained	ORIF with 6 Hole	15	43	Wound infection
2	Fracutre R. angle	RTA	Yes	Extracted	ORIF with 6 Hole	23	35	No
3	Fracutre L. angle	RTA	Yes	Extracted	ORIF with 6 Hole	24	40	No
4	Fracutre L. angle	RTA	Yes	Retained	ORIF with 6 Hole	13	35	No
5	Fracutre R. angle	RTA	Yes	Extracted	ORIF with 6 Hole	15	45	No
6	Fracutre L. angle	RTA	Yes	Extracted	ORIF with 6 Hole	15	45	No
7	Fracutre L. angle	RTA	Yes	Retained	ORIF with 6 Hole	17	46	No
8	Fracutre R. angle	RTA	Yes	Retained	ORIF with 6 Hole	27	46	No
9	Fracutre R. angle	RTA	Yes	Retained	ORIF with 6 Hole	28	40	No
10	Fracutre R. angle	RTA	Yes	Retained	ORIF with 6 Hole	20	43	No

TABLE 1:INTRAOPERATIVE TIME:

S.NO	GROUP I	GROUP II
1.	59	66
2.	51	66
3.	55	66
4.	51	66
5.	51	66
6.	55	57
7.	59	66
8.	51	57
9.	59	57
10.	51	57

TABLE 2:OCCLUSION:

S.NO	GROUP I		GROUP II	
	PRE OP	POST OP 3RDMONTH	PRE OP	POST OP 3RDMONTH
1.	2	2	2	1
2.	2	2	2	1
3.	2	3	3	1
4.	2	2	2	1
5.	2	2	2	1
6.	2	2	2	1
7.	3	2	2	1
8.	2	2	2	1
9.	2	2	2	1
10.	3	2	2	1

SCORE:1-NORMAL 2-MILD DISCREPANCY 3-NO OCCLUSION

TABLE 3:WOUND INFECTION / DEHISCENCE

S.NO	GROUP I		GROUP II	
	PRE OP	POST OP	PRE OP	POST OP
1.	NO	NO	NO	YES
2.	NO	NO	NO	NO
3.	NO	NO	NO	NO
4.	YES	NO	YES	NO
5.	NO	YES	YES	NO
6.	NO	YES	NO	NO
7.	NO	NO	NO	NO
8.	NO	NO	NO	NO
9.	NO	NO	NO	NO
10.	NO	NO	YES	NO

TABLE 4:MOUTH OPENING IN mm.

S.NO	GROUP I		GROUP II	
	MOUTH OPENING IN mm		MOUTH OPENING IN mm	
	PRE OP	POST OP 3RD MONTH	PRE OP	POST OP 3RD MONTH
1.	16	35	15	43
2.	15	35	23	35
3.	28	50	24	40
4.	20	50	13	35
5.	28	45	15	45
6.	20	40	15	45
7.	18	53	17	46
8.	27	42	27	46
9.	14	45	28	40
10.	25	40	20	43

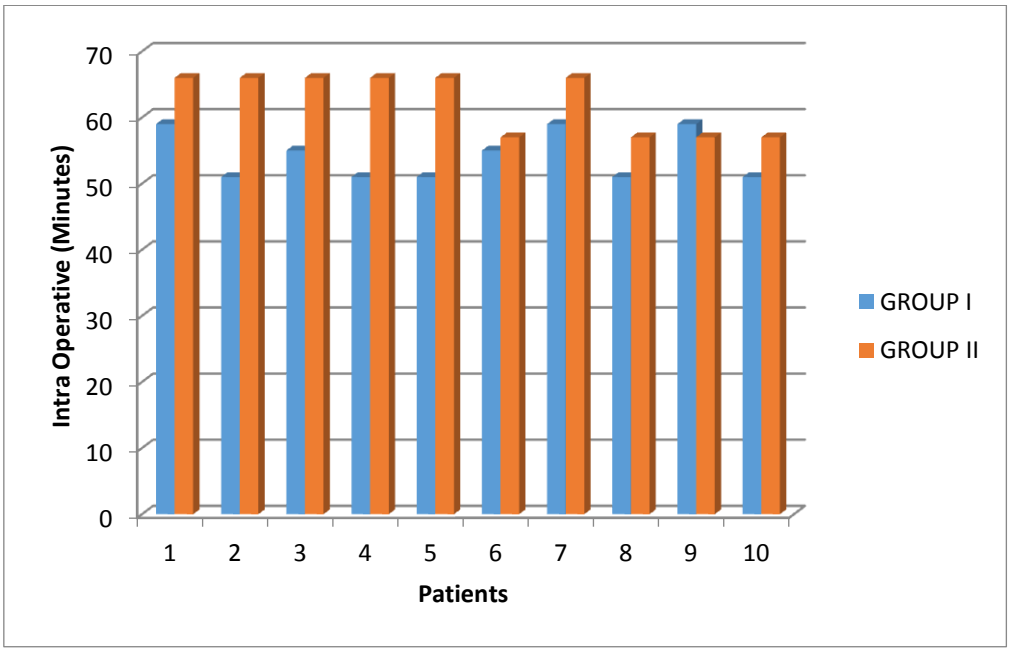
TABLE 5:BITE FORCE

S.NO	GROUP I				GROUP II			
	PRE OP		POST OP 3RD MONTH		PRE OP		POST OP 3RD MONTH	
	A	UA	A	UA	A	UA	A	UA
1.	0.8	1	4.0	37	1.3	2	34.5	38
2.	0.4	1	34.8	37	1.4	1	35.6	38
3.	0.8	3	35	40	2.8	4	36	40
4.	1.4	2	34	38	2.0	2	36	38
5.	1.5	2	35	44	1.4	3	52	38
6.	6.6	12	52	40	1.4	2	35.6	44
7.	6.5	7	28	58	0.6	1	38	42
8.	2.4	3	43	37	0.8	2	38	40
9.	11.4	12	38	46	3.2	10	35	40
10.	2.4	1	35	43	2.6	4	45	54

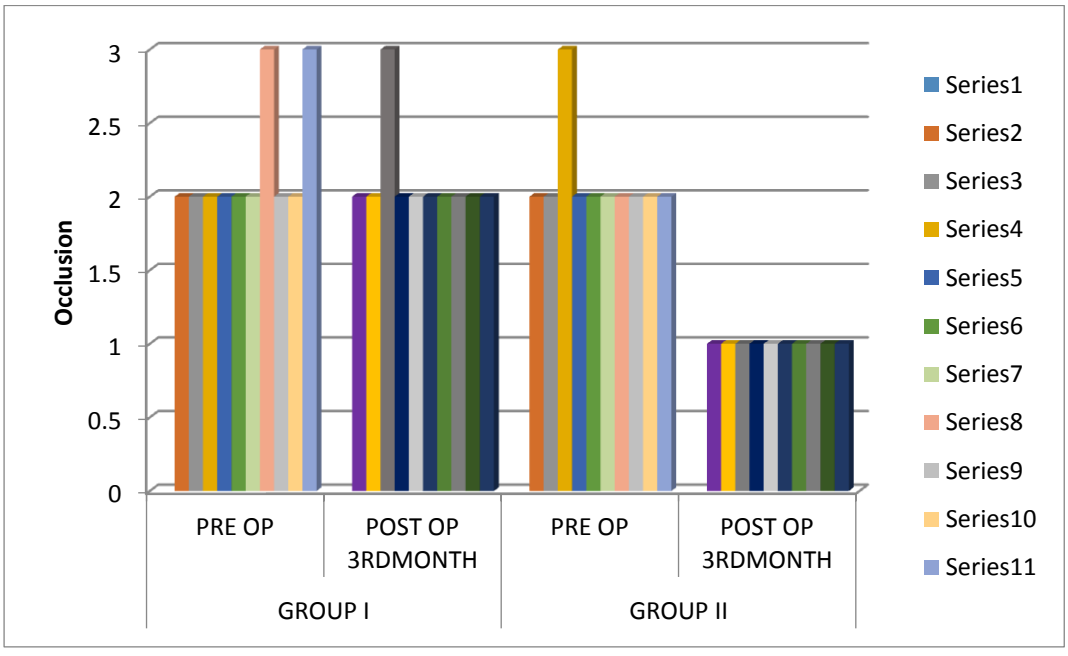
TABLE-6: NEUROSENSORY DEFICIT

S.NO	GROUP I		GROUP II	
	PARAESTHESIA		PARAESTHESIA	
	PRE OP	POST OP 3RDMONTH	PRE OP	POST OP 3RD MONTH
1.	YES	YES	YES	YES
2.	NO	NO	NO	NO
3.	NO	NO	YES	NO
4.	NO	NO	YES	NO
5.	NO	NO	YES	NO
6.	NO	NO	YES	NO
7.	NO	NO	YES	NO
8.	NO	NO	YES	NO
9.	NO	NO	NO	NO
10.	NO	NO	NO	NO

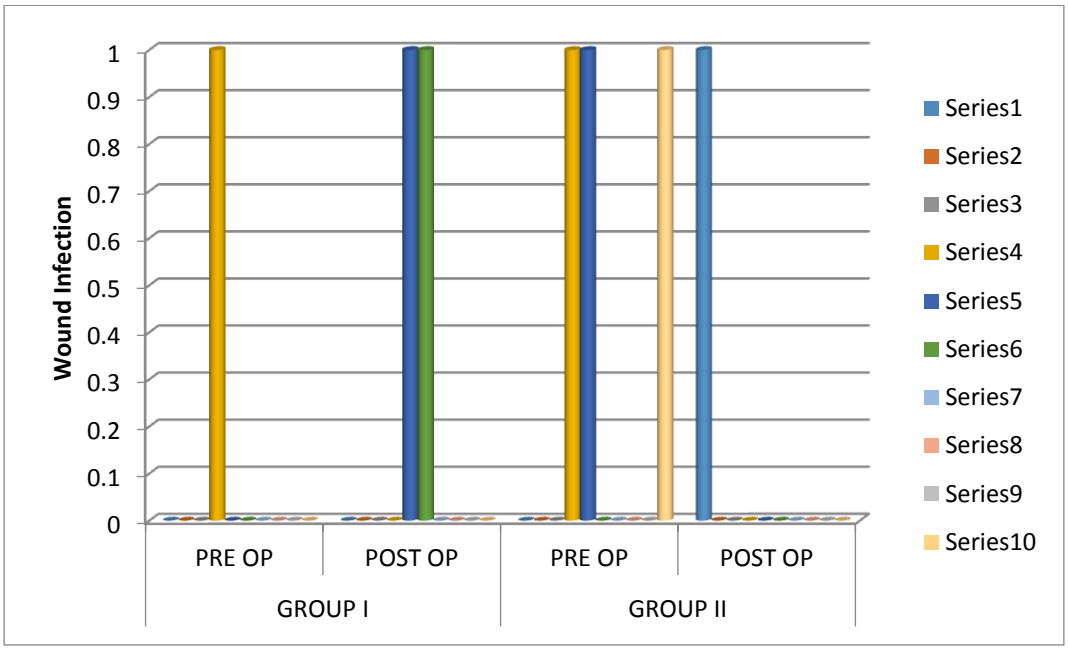
GRAPH 1: INTRAOPERATIVE TIME



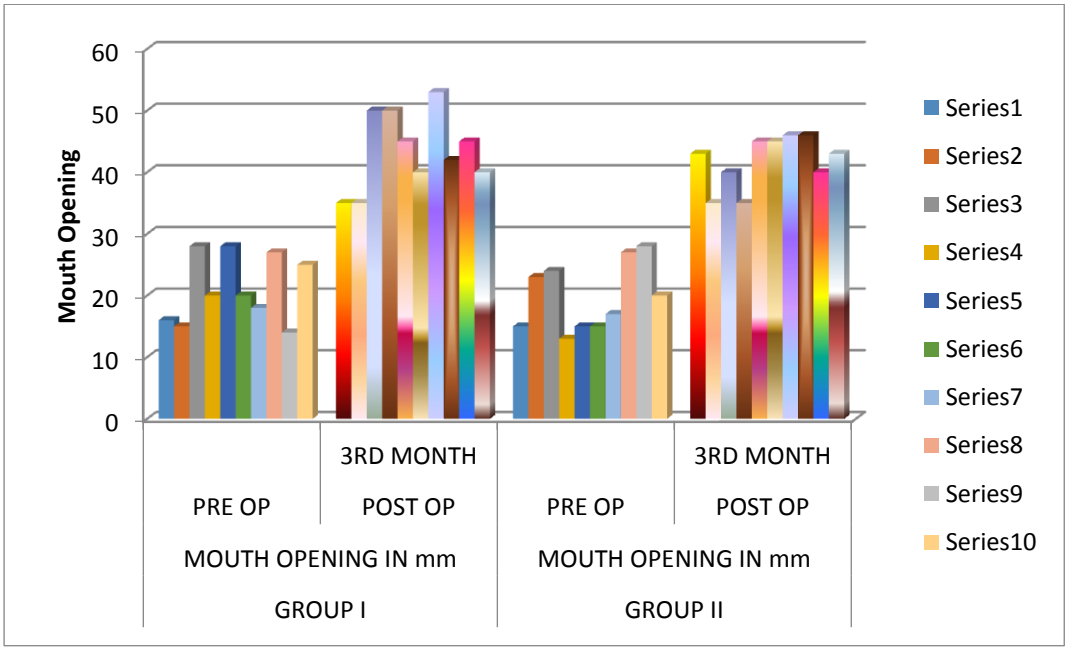
GRAPH 2: OCCLUSION



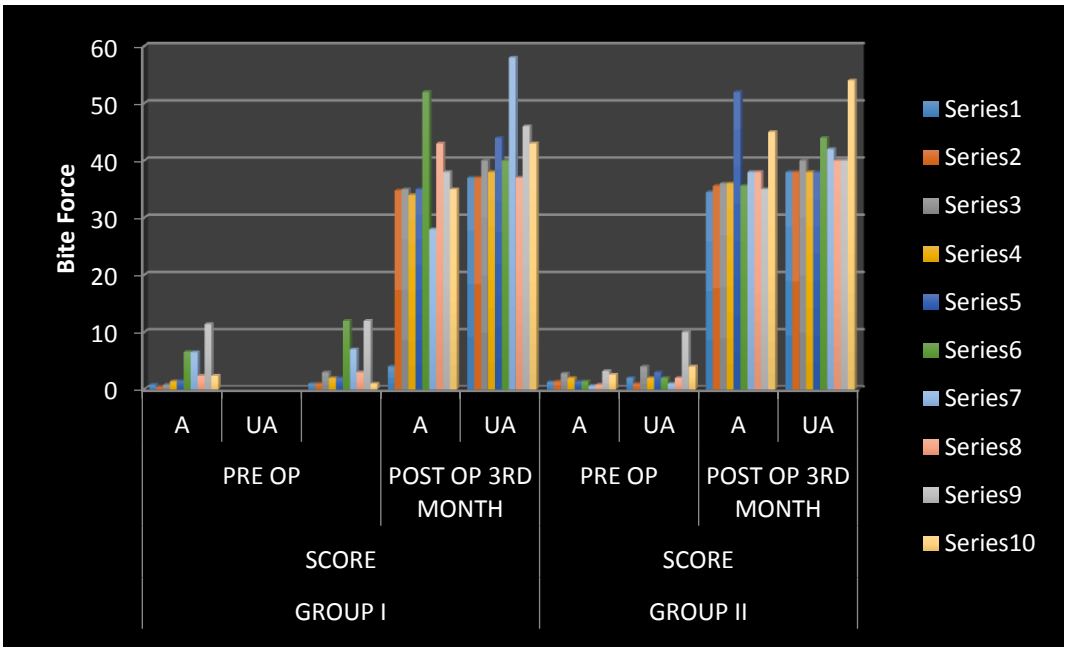
GRAPH 3: WOUND INFECTION / DEHISCENCE



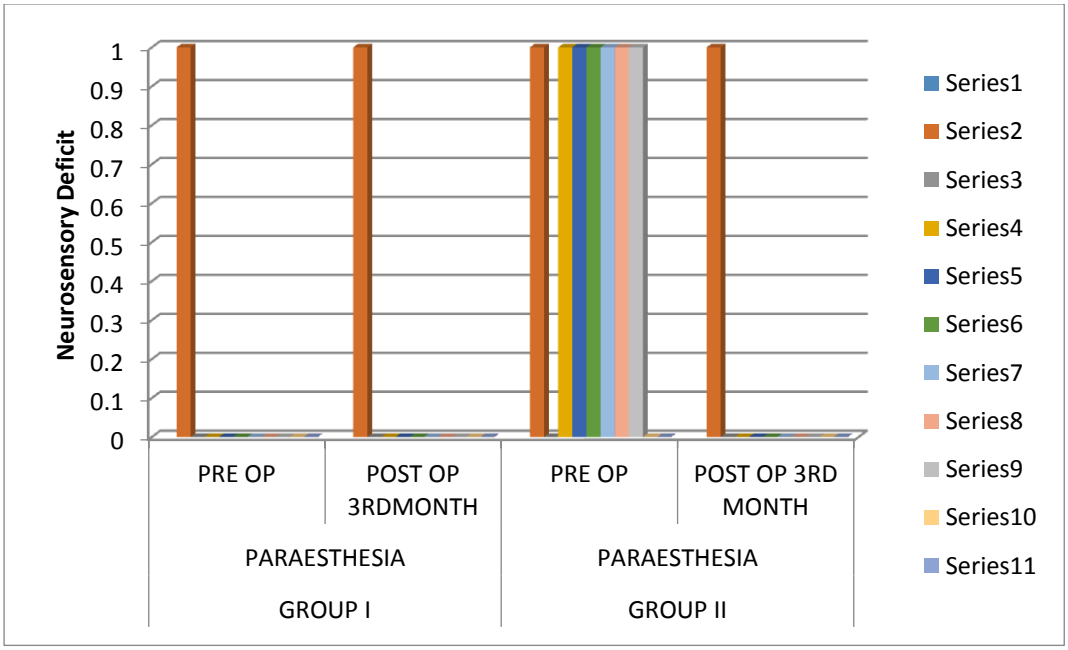
GRAPH 4: MOUTH OPENING IN mm.



GRAPH 5: BITE FORCE



GRAPH 6: NEUROSENSORY DEFICIT



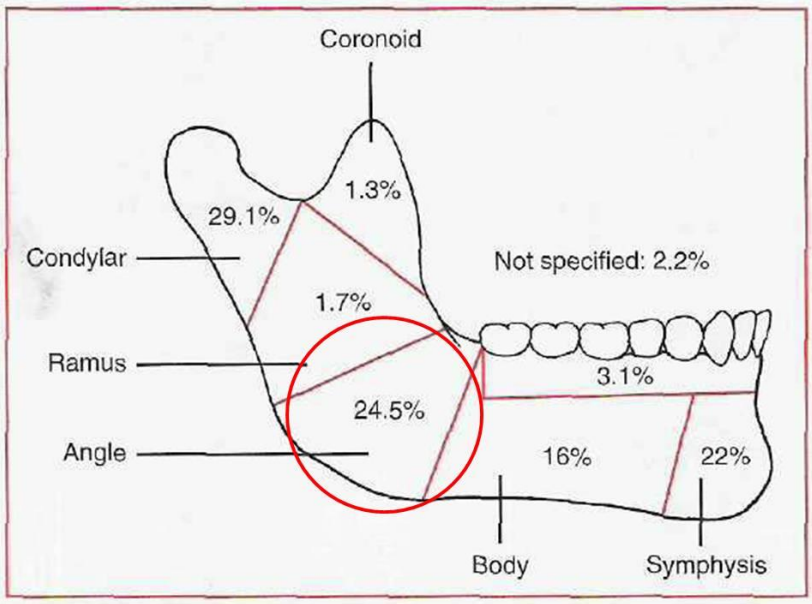
The most frequent site in the mandible to be fractured in cases of an isolated fracture is the angle of the mandible, (Ellis, moos and El Atlar & Haugh et al) . The angle fractures were more common in males and more frequently in the second and third decade of the population. In the present study 90% of the cases reported with fracture angle of the mandible were males the age group ranging between 20 years to 45 years which correlated with other studies.

Pattern & direction of fractures

depends on,

1. Amount of energy exerted by the force,
2. Direction of the vector of the force,
3. Muscle attachment and their counteracting forces,

Incidence & Distribution of fracture –Angle fracture



Characteristics of Fracture

Certain characters provide useful information on the nature of the injury,

1. Location of the fracture, (in this case it is angle)
2. Complete or incomplete,
3. Simple or Compound
4. Linear or comminuted,
5. Displaced or nondisplaced,
6. Mobile or nonmobile.

Displaced fracture angle of the mandible

Fractures of the angle account for about 23-42% of all mandibular fractures.[5] The reason for this high incidence could be attributed to the thin cross sectional bone area and the presence of a third molar. The variables such as bone density and mass, severity, direction and the point of impact are the other confounding factors that influence the site of fracture.

In the reported study 90% of the angle fractures were due to road traffic accidents. This is in contrast with most of the reports from the western countries where assault was found to be the common cause. Dwan and Zhang stressed the importance of the mechanism of injury and stated that in cases of injury caused

by a moderate traumatic force fracture resulting at two sites in the mandible, then the impacted third molars played an important role in angle fracture.[6]

A study done by Krishnaraj et al assessed the impact of mandibular third molars on mandibular angle fracture. The study confirmed that there was an increase risk of angle fractures depending on the position of the third molars. It was found that angle fractures were more often involved in patients with completely or partially impacted third molars. The similar finding was noted in the current study.[23]

Studies by Ma'aita and Aurkat and Iida et al reported that when the third molars were in position C and level 3 there was a greater risk of fracture. The hypothesis behind this being that a third molar occupies the osseous space thereby weakening the angle region.

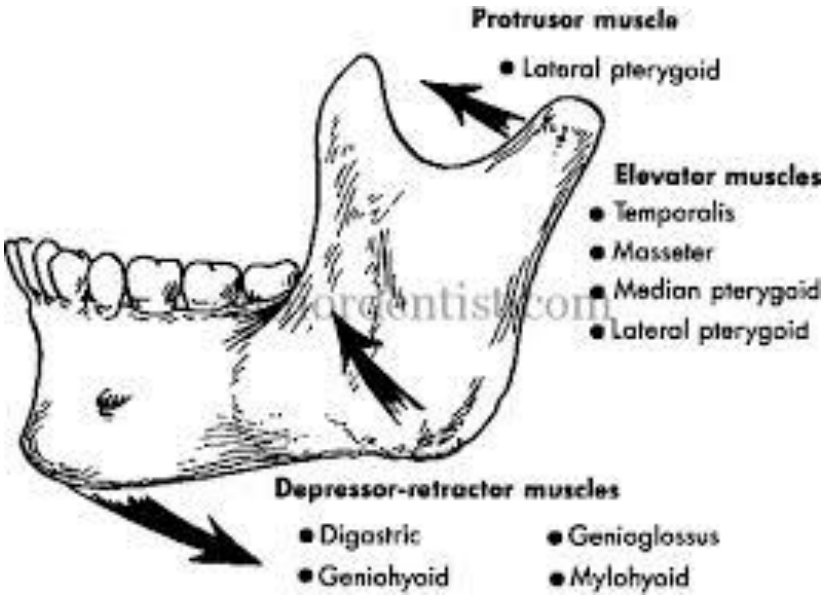
However few authors showed that superficially impacted third molar were associated with an increased risk of fracture than deeply impacted third molars. This is in accordance with the biomechanical study by Meisami et al which suggested that the strength of the mandible is derived from a maintenance of cortical and not medullary bone integrity. Since the superficially located third molar disrupt the cortical integrity of the external oblique ridge, thereby producing a point of weakness, and hence increasing the risk of fracture. But in the present study it was noted that the presence of deeply impacted third molars increased the incidence of mandibular angle fracture compared to superficially located third molars.

A study done by Edward Ellis on the outcome of patient with teeth in the line of mandibular angle fractures treated with stable internal fixation concluded that there is an increased risk for post operative complications when a tooth is present, but the increase is not statistically significant.[30] In accordance with this principal mobile, infected and fractured teeth, and teeth which interfered with the reduction of fracture were removed in the reported study.

The treatment of angle fracture has always been controversial. The biomechanics of the angle region is very complex such as a thin cross sectional area, abrupt change in the curvature, attachment of masticatory muscles and finally the presence of the third molars are the contributing factors for this complexity.

Applied anatomy/ biomechanics

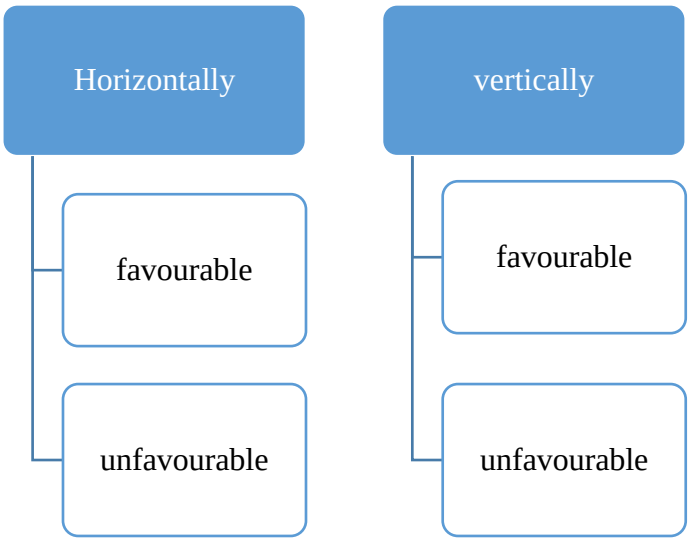
1. Elevator muscles exert bite force- 300 -400N normally,
2. Force reduced in fracture for several weeks,
3. CNS inhibits full contraction,
4. CNS perceives from the mechanoreceptors in the bone & soft tissue around the fracture.
5. Fixation schemes do not have to resist the normal forces, only to counter the reduced forces generated in patients with fracture.
6. Reduced contraction of the elevator muscles allow the ramus to rotate upward and forward,
7. Displacement at the superior border is worsened by the depressor muscles displacing the anterior mandible downward and backward.



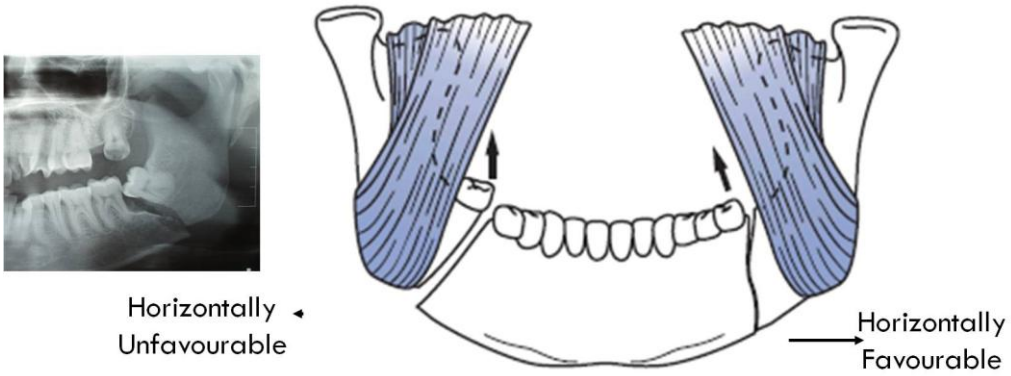
Principle of favourableness:

Based on the,

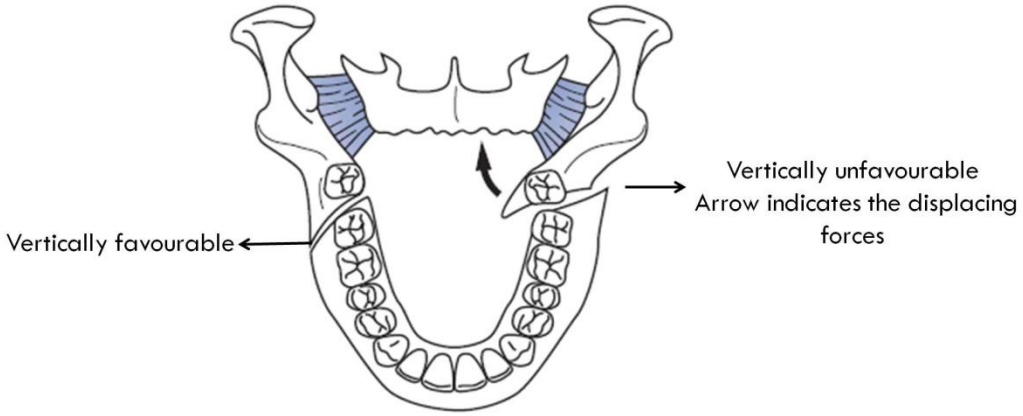
Direction of a fracture line and the displacement viewed on radiographs,



Horizontally – Favourable & Unfavourable fracture angle of the mandible



Vertically Favourable & Unfavourable



Basic principles in fracture management

1. Reduction – closed reduction,

   - open reduction,

2. Fixation – nonrigid / semirigid (wire osteosynthesis, miniplate osteosynthesis)

   - rigid, (two lag screws, two miniplates, reconstruction plates)

3. Immobilisation,

4. Supportive therapies.

Goals of treatment

1. Restore normal occlusion,
2. Restore proper function by ensuring union of the fractured segments,
3. Re - establishing pre injury strength,
4. Restore any contour defect that might arise as a result of the injury,
5. Prevent infection at the fracture site,
6. Masticatory ability to be improved,
7. Ability to speak normally to be achieved,
8. Articular movements to be established to the preinjury stage.

The lack of understanding of this complex biomechanics of the angle of mandible has resulted in numerous treatment modalities ranging from closed reduction to open reduction with non rigid fixation by means of trans osseous wiring, circum-mandibular wiring or small positional bone plates to AO reconstruction plates, dynamic compression plates and bio degradable plates. Inspite of a great deal of research, treatment modalities, and conflicting philosophies no consensus has been reached yet on the protocol for management of the angle fractures.

The approaches for the management of angle fractures can be intra oral or extra oral. The extra oral approach will often cause an undesirable scar,injury to marginal mandibular branch of the facial nerve. On the other hand the accessibility to the fracture site and for fixation in case of highly displaced fractures or for compression plating the extra oral approach is considerably superior compared to the intra oral route.[32]

The advantages of an intra oral approach are avoidance of an external scar, ease of removing teeth or fragments in the fracture line, simultaneous control of the occlusion and repositioning of the fragments during the surgery, and direct visualization of the occlusion during placement of bone plates or wires.[3]

The disadvantages of an intraoral approach are possible infection and poor exposure of more posteriorly positioned fracture in which access may be limited. A study was done by Vincent et al where the complication rates and other factors were compared between transoral versus extra oral reduction of mandibular fractures.[12] It was reported that intra oral exposure had higher complication rates, the reasons that were attributed for this higher complication rates were,a longer operative time in a contaminated field, increased surgical trauma and excessive manipulation of the tissues.

The indications for an extraoral approach are fractures posterior to the insertion of the masseter muscle as it provides better exposure and control of the proximal fragment allowing improved reduction and fixation, comminuted fractures where a reconstruction plate is most often needed for enhanced stability and fractures of edentulous, atrophic mandibles.In the reported study, an intra oral approach was preferred as the fractures were isolated, minimally displaced and in contrary to the above mentioned study no major complications were present.

Ewers and Harle reported in their article that the first description of mandibular fracture fixation using plates and screws was done by Hausmann in 1886. The conventional maxillo mandibular fixation does not provide adequate

stabilization since the bone in the mandibular angle area is thin inferiorly and fracture mostly occurs posterior to the dentition. Unstable rotation or distraction of proximal and distal fracture segments occurs most often as a result of opposing forces of the elevator and the depressor group of muscles.

The complications associated with a MMF are oral airway compromise, poor nutrition, patient dissatisfaction and non compliance, TMJ disorders and social inconvenience.[8]Hence in the current study open reduction was considered to avoid these discomforts for the patient. Since 1970s there have been two main schools of thought for open reduction and fixation of the fractures.

The AO/ Association for the study of internal fixation group advocated the concept of rigid fixation by compression there by achieving nil inter fragmentary mobility resulting in primary bone healing. The original AO technique was later modified using a single non-compression tension band plate at superior border and a compression plate at the inferior border.

The use of two points of fixation has been found to increase the complication rate as reported by Ellis where he states that "Wherever two points of fixation were used for fractures of the angle, the complication rate was much higher than when one point of fixation was applied". The higher complication rate could be because of greater periosteal and muscle stripping in the angle region thus compromising the healing and stabilizing action of the muscles.

The other school of thought was suggested by Michelet et al who introduced monocortical non compression miniplates. The studies by Champy et al using a cantilever beam model showed that the superior border of the mandible was subjected to tension and splaying and inferior border to compression, but this model was found to be inconsistent with the geometry and boundary conditions of the mandible. The tension and compression zones depending on load position tend to be reverse as reported by kroon et al and Rudderman et al. In addition Rudderman et al pointed towards the significance of soft tissue in stabilization of fractures and the existence of facial force circuits that transmit the force through bone, soft tissue and activated muscle as well as fascia.

There is an emerging trend of using a minimal hardware for the angle fracture. Ellis concluded in his study that the most effective method of fixation were either an extra oral ORIF with the AO/ASIF reconstruction plate or intra oral ORIF using a single miniplate. Based on this in the reported study, a single miniplate along the superior border was used in both Group-I and Group-II patients.

The advantages of miniplateosteosynthesis over rigid internal fixation are intra oral incisions minimizing or eliminating the need for a large external scar, decreased risk of injury to marginal mandibualr nerve .[3] In addition the miniplates are easier to adapt on the bony curvature than compression or reconstruction plate. All these advantages of a miniplate fixation were experienced by us in this study. Marisa et al in their study on fixation of mandibular fractures with 2mm miniplates reported 7.85% incidence of infection, malunion in 1.78%,

paraesthesia in one patient. Similarly in our study only two patients had wound infection and there was no incidence of any malunion.

David et al in their study on the use 7 hole angle plate for mandibular angle fractures suggested the following parameters for the placement of 7 hole angle plate such as,[1]

1) Failure to reduce or fix using miniplate technique.
2) Secondary fractures Eg: condylar fracture necessitating rehabilitation.
3) Bone loss from extraction of third molar.
4) Loss of posterior support, no posterior occlusion.
5) Diminished bone stock as found in partially edentulous mandible.
6) Traumatic or inflammatory bone loss.
7) Late fracture treatment, obliquity or instability.
8) Infection of fracture requiring more rigid fixation.

Based on the same parameters 6 hole miniplate were used in these situations in the reported study.Ayman et al in a prospective study on the role of transoral 2mm locking miniplate fixation of mandibular fracture plus one week of maxillo mandibular fixation reported primary bone healing in 98% of cases and wound dehiscence and mal occlusion in one patient.

In this study two weeks of MMF was followed and there was primary bone healing in all the cases and normal occlusion was achieved in all patients.Studies on fixation of mandibular angle fracture with 2mm 3 dimensional curved angle strut plate suggested that the strut plate allows for almost no

movement at the superior and inferior borders with minimal torsional and bending forces as opposed to a single plate applied to the superior border. It is reported that when only a single plate is placed at the superior border, torsional and bending forces usually cause movement along the axis of the plate with buccal or lingual splaying and gap formation at the inferior border respectively. Because the screws in a strut plate are placed in a box configuration on both sides of the fracture rather than on a single line, broad platforms are created that may increase the resistance to torsional forces along the axis of the plate. The greater resistance to splaying of the inferior border with a strut plate is because of the strut plate is conceptually 2 linear plates connected by a reinforcing vertical strut.[4]

In contrary to the above study in both the 4 hole and 6 hole miniplates used in Group-I and Group-II patients in this study no buccal or lingual splaying or gap formation at the inferior border were noted.

Haug studied the ability of various screw lengths and number of screws per fragment to resist displacement when used as tension band in a simple beam model with bovine ribs. He found that the length of the screw was insignificant, 4mm screws were as effective as longer lengths in resisting bone displacement in the model but there was a slight increase in rigidity of the system when three screws were used on each fragment as opposed to two.

This parallel finding was noted in this study where as far as the stability of fragments were concerned, six hole miniplate with three screws on either side of

the fracture was clinically considered as far superior than 4 hole miniplate placed with two screws on either side of the fracture.

Champy et al originally recommended that miniplates should not to be used to treat infected fractures. However the successful treatment of infected mandibular fractures with internal fixation devices has been reported by Becker, Tu and Tenhulzen, Kovery and Ellis.Johansson et al treated 37 patients with 42 infected mandibular fractures using miniplates. Approximately 10 of these fractures were in the angle. Uncomplicated healing occurred in 76% of patients.

In this study, preoperatively there was wound infection in 3 patients in Group-II and one patient in Group-I, which were treated with appropriate antibiotics and a good control over the infection was obtained before treating the patients with open reduction and internal fixation. Post operatively uncomplicated wound healing was seen in 85% of patients.

The reason for applying MMF is to immobilize the mandible until the soft tissue incision has healed. Some surgeons believe in applying post surgical MMF to 'settle' the occlusal relationship after the fixation of the fracture with the bone plate. In the reported study all the patient in group-I and group-II were placed with MMF for two weeks for the above mentioned reasons.

Champy et al and Cawood et al recommended that miniplate osteosynthesis must be performed soon after injury to minimize the incidence of dehiscence and infection. Unfortunately many of the patients did not present for

the treatment until 7 days after their injury. Because of this the patients were treated as soon as they reported to the department with injury.

Clinically it was not possible to detect any difference in complication rates for those fracture treated early or late since all the patient responded well both to the pre-operative and post-operative antibiotics. Lack of such a relationship has also been found by Smith, Barnard and Hook and Tuovinen et al in their studies.

Champy et al were able to define the strains within the bone based on the muscular activity. In the angle region only movements of flexion were found, with a maximum force of 600N in the angle. Based on this a miniature plate with self threading screws resistant to the calculated bending forces upto 600N was developed and recommended for use.

In a study by Tate et al, vertical bite forces after the treatment of angle fractures using two miniplates were analysed, they found that at 6 weeks post operatively the bite force was 52% of molar forces. Gerlach et al reported a biting force of 148N at 6wks post operatively. In the present study the biting forces achieved in the affected side post operatively was 34Kg in a 3 month follow up.

Fractures of the mandible is very common than the fractures of the other facial bones, constituting two thirds of the maxillofacial fractures. Inspite of the mandible being dense and strong, it is frequently exposed to trauma and is liable for fracture. The main goal in the surgical management of the fracture of the mandible is to restore the form and function with minimal disability and shortest period of recovery. Miniplate osteosynthesis advocated by champy et al for the mandibular angle fracture is a reliable and very effective technique for providing rigid fixation.

Comparison between the placement of 4 hole 2mm miniplate and a 6 hole 2mm miniplate in this study suggests that there is a better stability of fragments when three screws were placed on either side of the fracture. There is not much of difference in the incidence of complication such as malunion, non union and a wound dehiscence or wound infection in using 6 hole and 4 hole 2mm miniplate.

However there is a difficulty in placing the 6 hole 2mm miniplate over the external oblique ridge and also in accessing the retromolar trigone during the last screw placement when compare to the 4 hole miniplate which is smaller in size . The adaptability of the plates was much better in both the 4 hole and 6 hole 2mm miniplate, but clinically the intra operative time was longer in the 6 hole miniplate than the 4 hole miniplate.

To conclude, both the 2mm- 4 hole and 6 hole miniplate osteosynthesis provides favourable clinical outcomes in treating the isolated unilateral fracture angle of the mandible with minimal complications. However further studies with a larger sample size eliminating the confounding factors are required to ascertain the clinical benefits of one type of plate over the other.

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CASE SHEET

"COMPARISON OF SIX HOLE V/S FOUR HOLE MINI PLATES FOR OPEN REDUCTION AND INTERNAL FIXATION OF ISOLATED, UNILATERAL FRACTURE ANGLE OF MANDIBLE"

PATIENT'S NAME :_____

AGE/ SEX : _____

PATIENT'S

IDENTIFICATION NO : _____

CONTACT ADDRESS : _____

_____

CONTACT NO : _____

INSTITUTION : TN Govt. Dental College & Hospital,
Chennai - 600 003.

CENTRE : Dept. of Oral & Maxillofacial Surgery,
TN. Govt. Dental College and Hospital,
Chennai - 600 003

CHIEF COMPLAINT:

HISTORY OF THE PRESENTING ILLNESS:

CLINICAL FINDINGS:

INVESTIGATIONS:

TREATMENT:

Procedure followed : Open reduction and internal fixation

FOLLOW UP

1.Occlusion.

2. Bite force.

3. Mouth opening.

4. Neuro sensory deficits.

5. Wound infection & dehiscence.

NAME OF THE INVESTIGATOR :

SIGNATURE OF INVESTIGATOR :

INFORMED CONSENT

INFORMED CONSENT

COMPARISON OF SIX HOLE VS FOUR HOLE MINI PLATES FOR OPEN REDUCTION AND INTERNAL FIXATION OF ISOLATED, UNILATERAL FRACTURE ANGLE OF MANDIBLE

Patient's Identification No: _____ Patient's Name: _____
Patient's DOB: dd_____ mm_____ yyyy_____

I confirm that I have read and understood the Information Sheet for the above study have had the opportunity to ask questions and all my questions and doubts have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected.

I understand that the Clinical study personnel, the Ethics Committee and the Regulatory Authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to the third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study.

I agree not to withhold any information about my health from the investigator and will convey the same truthfully.

I agree to take part in the above study and to comply with the instructions given during the study and to faithfully co-operate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or wellbeing or any unexpected or unusual symptoms.

I am aware that my jaw fracture can be treated by small incision inside mouth and exposing the fracture site, reduced and fixed with small 6 hole titanium (or) 4 hole titanium plate with screws and closed with 3-0 vicryl suture, temporarily immobilizing the jaws for 2 weeks with wires. I was explained about the surgical methods (under local or general anesthesia) of treating the jawfracture using plates and screws and chose the surgical option on my own wish. I was also informed about the side effects of local anaesthesia (or) general anaesthesia and surgical procedure. I hereby consent to participate in this study.

I consent to give my medical history, undergo complete physical examination and diagnostic tests including hematological, biochemical and urine examination etc.

Signature/Thumb Impression:_____ Place: _____ Date: _____
Patient's Name & Address: _____
_____
Signature of the Investigator:_____ Place: _____ Date: _____
Study Investigator's Name: _____
Institution: _____
Signature of the Witness:_____ Place: _____ Date: _____
Name & Address of the Witness: _____
_____ * Mandatory for uneducated Patient (Where thumb impression has been provided above)

சுய ஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு

கீழ்தாடை எலும்பு முறிவிற்கான டைடானியத்தால் செய்யப்பட்ட ஆறுதுளைகளை உடைய பிளேட்டிங்கையும், நான்கு துளைகளை உடைய பிளேட்டிங்கையும் ஒப்பிடுதல்

ஆராய்ச்சி நிலையம் : தமிழ்நாடு அரசு பல் மருத்துவக் கல்லூரி
சென்னை – 600 003

பங்கு பெறுபவரின் பெயர் :

பங்கு பெறுபவரின் எண் :

பங்கு பெறுவரின் பிறந்த தேதி : _____ / _____ /_____
தேதி மாதம் வருடம்

அறுவை சிகிச்சை சம்பந்தமாக நான் மேலே கூறப்பட்ட தகவல் படிவத்தை முழுமையாக படித்துப் பார்த்தேன் என்று உறுதி கூறுகிறேன். நான் இது தொடர்பான அனைத்து கேள்விகளுக்கும் நிறைவான பதில்கள் பெறப்பட்டேன்.

இந்த ஆய்வின் எனது பங்கு தன்னிச்சையானது என்றும் எந்த நேரத்திலும் இந்த ஆய்வில் இருந்து சட்ட உரிமைகள் பாதிக்கப்படாமல் விலகிக் கொள்ள சம்மதிக்கிறேன்.

மருத்துவ ஆய்வு அதிகாரிகள், எனது சிகிச்சை தொடர்பான பதிவேடுகளை பார்வையிடவும் எந்த நேரத்திலும், ஆய்வில் இருந்து நான் விலகினாலும் பார்வையிட சம்மதிக்கிறேன். எனது அடையாள குறிப்புகள் மூன்றாவது நபருக்கு தெரிவிக்கப்படமாட்டாது என்று புரிந்து கொண்டேன்.

இந்த ஆய்வு அறிக்கைகளை பயன்படுத்தவும், வெளியிடவும், நான் சம்மதிக்கிறேன். ஆய்வாளர் எனது மருத்துவக் குறிப்புகளை வெளியிட தடையாக இருக்கமாட்டேன் என உண்மையாக சம்மதிக்கிறேன்.

நான் இந்த ஆய்வுக்கு முன்னர் கூறிய மருத்துவ குறிப்புகளின்படியும் உண்மையாக சம்மதிக்கிறேன். மேலும் எனக்கு உடல் நிலை சரியில்லாத பட்சத்தில் ஆய்வாளர்களுக்கு தெரியப்படுத்த சம்மதிக்கிறேன்.

நான் ஆய்வு குழுவிற்கு முழு ஒத்துழைப்பு அளிப்பேன் என்றும் எனது உடல்நிலையில் ஏதேனும் உபாதைகள் ஏற்பட்டால் அதனை உடனே ஆய்வாளருக்கு தெரிவிப்பேன் என்று உறுதியளிக்கிறேன்.

பொது மயக்க மருத்துவ முறையிலோ/ பகுதி உணர்வகற்ற மூலமாகவோ எனது கீழ்தாடை எலும்பு முறிவிற்கு டைட்டானியம் பிளேட் மற்றும் டைட்டானியம் ஸ்குரு பொருத்தி அறுவை சிகிச்சை செய்யப்படுகிறது என்பதை நான் அறிந்துகொண்டேன். என் முழு சம்மதத்துடன் எனக்கு என் வாயினுள் சிறு அறுவை சிகிச்சையின் மூலமாக உடைந்த தாடையின் பகுதியினை கண்டறிந்து, உடைந்த எலும்பினை சரிசமமாக உடற்கூறு அமைப்பில் வைத்து பின் 6 துளைகள் அல்லது 4 துளைகள் உடைய டைட்டானியம் பிளேட்டிங்கினை பொருத்தியபின் 3-0 வைக்கிரல் தையல் போடவும், பின்பு தற்காலிகமாக கீழ் தாடையினை நகராமல் மேல் தாடையுடன் பொருத்தி 2 வாரங்கள் வைக்கவும் சம்மதிக்கிறேன். இந்த அறுவை சிகிச்சை மூலம் ஏற்படும் அனைத்து பக்க விளைவுகளையும் மருத்துவர் மூலம் அறிந்து கொண்டு இந்த ஆய்விற்கு என்னை உட்படுத்திக்கொள்கிறேன்.

நான் எனது மருத்துவ குறிப்புகளை தரவும், மேலும் முழு உடல் பரிசோதனைக்கும் இரத்தம், சிறுநீர் மற்றும் உயிர் வேதியியல் நோய் அறிதல் சோதனைகளுக்கும் முழுஒப்புதல் அளிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம் ..... இடம்..... தேதி.....

கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....

ஆய்வாளரின் கையொப்பம் ..... இடம்..... தேதி.....

ஆய்வாளரின் பெயர் .....